



**ARIZONA GAME AND FISH  
DEPARTMENT**

**WILDLIFE WATER  
CONSTRUCTION STANDARDS**



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# ARIZONA GAME AND FISH DEPARTMENT WILDLIFE WATER DEVELOPMENT STANDARDS

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## FORWARD

Since assembling the first “Arizona guzzler” in 1946, the Arizona Game and Fish Department (Department) has constructed more than 900 wildlife water developments statewide. The first water developments were designed to support desert quail and upland game bird reintroduction efforts in the 1950s and early 1960s. Since then, the Department’s primary focus has remained on game species, with the exception of a handful of water developments built to specifically benefit non-game species. Over the last five decades, water development design, site selection, materials, and construction methods have continued to evolve. This has resulted in an array of catchment types, some functioning well, others not, but all contributing to a growing maintenance load.

It is the Department’s commitment to achieve a financially sustainable water development program based on sound biological assessments, appropriate design, construction and material applications, and efficient resource allocation. To that end, one critical step was to develop this design standards manual by which the Department, its volunteers, contractors and other project proponents can construct facilities that optimize past design experience, utilize standardized materials, employ efficient construction methods and reduce life cycle costs. It is also the objective of this document to catalogue a sufficient variety of details and standards such that given the diversity of project specific parameters that can be anticipated in the development of man-made wildlife waters throughout Arizona, the following criteria can be met:

- A long lifespan (40-50 years for storage and collection systems, 25 years for drinking troughs).
- Standardized materials applied in accordance with manufacturer’s recommendations.
- Year-round, acceptable water quality for wildlife use.
- Maximized passive design elements.
- No supplemental water hauling required, except in rare or exceptional circumstances.
- Minimal visual impacts and blends in with the surrounding landscape.
- Construction details reflect efficiencies in both cost and time required.
- Minimal routine maintenance required.
- Accessible to and used by target species and excludes undesirable/feral species to the greatest extent possible.
- Minimized risk of animal entrapment and mortality.

The Department and its conservation partners have found that passive (no valves) underground system designs utilizing large volume tanks, or PVC tube type reservoirs with natural, hard surface aprons to ideally meet these criteria. These standards however are intended to provide a sufficient catalogue of components to support an assortment of configurations necessary to modify or redevelop existing

systems of various designs (to satisfy the above criteria), accommodate environmental compliance limitations or adapt new development designs to site-specific restrictions found in the field. This manual will be reviewed regularly for revision.

Prior to 2013, the majority of tanks and troughs installed for water catchments were constructed from fiberglass. The fiberglass products were becoming difficult and expensive for the Department to purchase. In 2013, the Department determined that polyethylene tanks, troughs and gutters would meet all of the objectives for the water catchments and is currently the most financially feasible option for the Department.

*Comments and input are welcome and can be submitted directly to the Engineering Section of the Department's Development Branch.*

## **SECTION 1 – GENERAL STANDARDS**

In the absence of special provisions, specifications, and details all work shall be constructed in accordance with the latest editions of these water development standards and details.

The construction of the water catchments shall follow all government guidelines and utilize appropriate suitable personal protective equipment during the performance of all work under these standards. All applicable State and Federal Standards including OSHA shall be met.

Arizona Game and Fish Department, Development Branch (623) 236-7485 can provide assistance in contacting current materials vendors.

### **1.1 AUTHORITY OF THE ENGINEER:**

The Arizona Game and Fish Department Operation Manual requires that all capital projects implemented by the Department are overseen by the Engineering Section (see Appendix A). As such, the Department's Engineer will decide all questions, which may arise as to the quality and acceptability of materials and work performed and as to the rate of progress of the work; all questions, which may arise as to the interpretation of the plans and standards.

The Engineer may, at his or her discretion, suspend the work wholly or in part due to the failure of the project; to correct conditions unsafe for the workmen or the general public; for failure to carry out provisions of the contract; for failure to carry out the Engineer's orders; for such periods as he or she may deem necessary due to unsuitable weather; for conditions considered unsuitable for the prosecution of the work or for any other condition or reason deemed to be in the public interest.

The Engineer may designate inspector(s), assistants or other field staff to assist the Engineer in observing the performance of the work.

### **1.2 CLEARING AND GRUBBING:**

The work site shall be cleared and grubbed in such a fashion as to minimize disturbance of adjacent property, utilities, natural drainages, geologic formations, trees and plants. Plants protected under environmental regulations shall be marked by Department staff and shall be avoided during all construction. Archeological resources shall be carefully preserved during construction and any collection or disturbance of such materials is strictly forbidden.

All stumps and roots shall be grubbed to 18 inches below finish grade. Cavities left by the removal of stumps or roots shall be carefully backfilled and compacted to a minimum 95% density.

### **1.3 AVAILABILITY OF WATER AND ELECTRICITY:**

The water catchments are typically in remote areas and water and electricity typically will not be readily available. Provisions shall be made to bring water and electricity to the work site if required.

### **1.4 WASTE MATERIALS:**

All unusable (waste) materials such as wood, rubbish, construction debris, waste asphalt and concrete shall be removed from the site and properly disposed of at a licensed waste disposal facility.

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## **SECTION 2 – TANKS**

### **2.1 POLYETHYLENE TANKS**

The standard catchment tank shall be a 2,500 gallon heavy-duty polyethylene below ground holding tank manufactured by Norwesco or an approved equivalent.

### **2.2 PVC “PIPE” TANKS**

All PVC pipe supplied for PVC “Pipe” tanks shall be C905 PVC with at least a pressure rating of 165 or greater. The PVC compounds used to manufacture the PVC pipe shall contain no deleterious ingredient in any amount that has been demonstrated to migrate into water in detectable quantities. PVC pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. The pipe shall be uniform in color, opacity, density and other physical properties. Any gaskets and/or lubricants used with PVC pipes and couplings shall be manufactured from materials that are compatible with the plastic material and each other when used together. The materials shall not support the growth of bacteria or adversely affect the potable quality of the water.

The pipe shall be permanently marked indicating size and pressure rating. The appropriate markings shall occur on the pipe at least once in every 24 inches. The seal of approval or marking of the testing laboratory shall be included in the marking on all pipe intended for transporting potable water.

PVC pipe shall be handled in accordance with AWWA Guideline M23. PVC pipe shall not be handled with individual chains or single cables, even if padded. Pipe shall not be dropped to the ground or rolled into the trench. Pipe shall not be dropped or rolled against other objects. All PVC pipe, couplings, caps and gaskets shall be stored covered so as to protect from exposure to sunlight, ozone and grease. PVC pipe shall be stored so as to not become deformed or bent during storage.

PVC pipe and fittings to be joined using a primer solvent-cement joining system which shall utilize only a manufacturer approved primer solvent-cement joining system.

Primer shall conform to ASTM F-656-80 and shall be purple in color.

Solvent-cement shall conform to ASTM D-2564 and shall be the proper type and viscosity according to pipe size. The solvent-cement shall be of a solution of Type 1, Grade 1, and non-plasticized PVC resin. The cement shall be free flowing and shall not contain lumps, microscopic un-dissolved particles or any foreign matter that will adversely affect the ultimate joint strength. It shall show no stratification or separation that cannot be removed by stirring.

Manufacturer's recommendations for joining pipe shall be strictly followed.

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## **SECTION 3 – TROUGHS**

### **3.1 WALK-IN TROUGHS**

Troughs are designed to provide access to the water source for wildlife. Walk-in troughs are to allow wildlife to enter the trough to access water at a low level. Troughs of all types shall be suitable for above ground or below ground installation. Rainmaker Wildlife or an approved equivalent, are of the type and design suggested for this application. The troughs shall be as indicated in the standard drawings 005 and 006. An escape ramp for small animals shall be built into the walk-in troughs.

### **3.2 FLOAT TROUGHS**

Float troughs are designed to provide an access to the water source for wildlife. Troughs shall be suitable for above ground or below ground installation. All float troughs shall be provided with small animal escape ramps.

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## **SECTION 4 – PRECIPITATION COLLECTION APRONS**

Dimensions and construction shall be as indicated in Standard Drawings 007, 008, 009, and 010.

#### **4.1 APRON SUB FRAME**

Apron panels will be assembled on top of a three run sub-frame running the entire length of the collection apron. This sub frame consists of 1 ½ inch upright schedule 40 black steel posts placed on 10 foot centers and cemented into the ground with 10 inch diameter x 24 inch-deep post holes. On top of the upright posts, 2 inch square tube with 3/16 inch wall thickness will be welded on which the panels will be assembled. Sufficient grade will be established by cutting the upright posts at the proper height to assure deliverance of collected rain water to the down gradient gutter. Panels will be tack welded in place on every 5<sup>th</sup> stud to the sub frame once squaring to the preceding panel has been achieved.

#### **4.2 APRON PANELS**

Precipitation collection aprons shall be constructed of one or more 24' wide x 20' long foot standard panels screwed together, arranged in rectangle(s) or square(s) and provided with standard polyethylene gutter(s) on the down gradient side(s) as shown in the detailed project plans and specifications. Individual panels shall be constructed of 16 gauge steel "C" channel frame, 4 inch steel track and 16 gauge steel studs covered with 26 gauge steel "R" panel roofing. Panels shall be factory finished with a baked-on enamel coating, the color of the enamel finish shall be as selected by the Engineer, with a minimum 1-year guarantee, to provide camouflage for the completed apron assembly. All assembly and materials shall be in accordance with the American Standard Association (ASA) Specification A24.4. All metal construction shall be so erected that finished surfaces shall be square and true to line and grade.

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### **SECTION 5 – TINAJA SEALANTS**

Tinajas (naturally occurring water pockets), which show evidence of leakage, may be sealed as required with wildlife-safe asphalt-epoxy coating, concrete-plasticizer coating, hydraulic cement, a layer of steel reinforced concrete or other products as directed by the Engineer. Care shall be taken to carefully clean and dry all surfaces to be coated using wire brushes, sand or bead blasting or very high-pressure water sprays.

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### **SECTION 6 – SHADE STRUCTURES**

Shade structures may be constructed over Tinajas or water collection points to lessen evaporation lose.

Shade structures shall be constructed of steel tubing posts and frames, 16 gauge steel "C" channel shade frame, 3 5/8 inch steel track, 16 gauge steel studs covered

with 26 gauge steel “R” panel roofing or other structural system as shown in Standard Drawing 024, indicated on the project plans or specifically allowed by the Engineer. The roofing panels shall be factory finished with a baked-on enamel coating, the color of the enamel finish shall be as selected by the Engineer to provide camouflage for the completed shade assembly. All assembly and materials shall be in accordance with the American Standard Association (ASA) Specification A24.4. All metal construction shall be so erected that finished surfaces shall be square and true to the line and grade indicated in the plans.

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## **SECTION 7 – GABIONS**

Gabions, which are constructed so as to limit or prevent accumulation of sand and silt in Tinajas and water catchments, shall be constructed from either locally available, on-site stone or imported stone, steel wire baskets and steel pipe or “T” post supports. Construction of any gabion greater than six (6) feet in height shall be undertaken only after completion of an engineering design, prepared by an Engineer registered to practice in the State of Arizona with specialization in either Civil or Structural Engineering. Prior to construction, two copies of the design shall be provided to the Department Engineer for review and approval. Construction of such a dam or water retention structure shall take place only under the direct supervision of the designing Engineer.

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## **SECTION 8 – DAMS**

Construction of any dam or other water retention structure greater than six (6) feet in height shall be undertaken only after completion of an engineering design, prepared by an Engineer registered to practice in the State of Arizona with specialization in either Civil or Structural Engineering, the design shall include any geotechnical evaluations and/or borings the Engineer may deem necessary. Prior to construction, two copies of the design shall be provided to the Department Engineer for review and approval. Construction of such a dam or water retention structure shall take place only under the direct supervision of the designing Engineer. Any and all documents required by the Arizona Department of Water Resources and/or the federal Army Corps of Engineers shall be in place before any placement of structures can begin.

### **8.1 MASONRY**

Construction of masonry dams shall be constructed of bond beam concrete block with reinforcing steel placed both horizontally and vertically throughout the structure and all cells fully filled with Portland cement concrete as shown in the Standard Detail. Dams shall be securely attached to sound bedrock with steel reinforcing bars

drilled and mortared into the rock. Reinforcement shall extend a minimum of 20 bar diameters into sound rock.

## **8.2 STONE**

As general practice, the construction of stone dams shall be limited to the construction of diversion dams along small intermittent watercourses in desert locals. Such dams shall be constructed of clean, sound stones and cement mortar and shall be “toed” into the subsurface as required to prevent undercutting by stream flows. Stone dams shall be limited in height above grade to no greater than 2 feet and shall be constructed as “gravity dams” with a height (above grade) to thickness ratio no greater than 1.25. Stone to be used in such dam construction shall consist of sound stones having a minimum of 4 fractured faces. Prior to placement, stones shall be carefully cleaned, to the satisfaction of the Engineer, with water and steel brushes insuring a secure bond to the surrounding cement mortar. Any and all documents required by the Arizona Department of Water Resources and/or the federal Army Corps of Engineers shall be in place before any placement of structures can begin.

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## **SECTION 9 – SAND POINTS**

Sand points are defined for the purposes of these specifications, as runoff collection facilities located in intermittent desert streams generally consisting of either a slotted well screen, 0.020 inch stainless steel mesh screen or other collection device as shown in the plans, located in a streambed. Sand points shall be constructed as shown in the project plans or Standard Detail 022. Any and all documents required by the Arizona Department of Water Resources and/or the federal Army Corps of Engineers shall be in place before any placement of structures can begin.

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## **SECTION 10 – FENCING**

### **10.1 STANDARD WILDLIFE FENCE**

Standard wildlife fencing shall consist of 4 wire strands, the top and bottom strands shall consist of 11 gauge galvanized steel wire and the center two shall consist of barbed wire of a 2 point pattern; composed of 2 strands of 12½ gauge galvanized steel wire with barbs spaced 5 inches apart, conforming to ASTM A-121. Wire shall be placed at the following spacing, the bottom wire 18 inches above the ground, the second wire 22 inches above the ground, the third wire 30 inches above the ground and the fourth or top 42 inches above the ground. Wire shall be placed on #133 steel “T” posts set solidly in the ground placed no further than 15 feet apart with two stays (wood preferred) set at 5 foot intervals between the posts. Corner and tension posts

shall be constructed of 3 inch diameter 3/16 inch wall steel pipe set into the ground in 18 inch diameter by 24 inch deep MAG Class "B" concrete footers.

## **10.2 ANTELOPE FENCE**

Antelope fencing shall consist of 3 wire strands, the top and bottom strands shall consist of 11 gauge galvanized steel wire and the remaining strand shall consist of barbed wire of a 2 point pattern; composed of 2 strands of 12½ gauge galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM A-121. Wire shall be placed at the following spacing, the bottom wire at least 20 inches above the ground, the second wire 30 inches above the ground and the third wire 42 inches above the ground. Wire shall be placed on #133 steel "T" posts set solidly in the ground placed no further than 15 feet apart with two stays (wood preferred) set at 5 foot intervals between the posts. Corner and tension posts shall be constructed of 3 inch diameter 3/16 inch wall steel pipe set into the ground in 18 inch diameter by 24 inch deep MAG Class "B" concrete footers.

## **10.3 ELK EXCLUSION FENCE**

Dimensions and construction shall be as indicated in Standard Detail 017. Elk exclusion fencing shall consist of 7' tall fencing with a 48" panel of 12½ gauge Class I field fence placed at 1'8" off the ground to 5' 8" off the ground.

The fencing shall be supported with 1-½ inch diameter steel pipe posts or 2 inch square tubing that is a minimum of 3/16 inch thick. Steel posts shall be set in 12 inch diameter by 24" inch deep MAG Class "B" concrete footers, alternatively posts set in rock may be grouted in to drilled holes. Posts shall be set no further than 10 feet apart.

Rails constructed from ¾ inch Schedule 40 black steel pipe shall be welded to the vertical posts at 20 inches, 42 inches, 68 inches from ground level. The top rail of the fence shall be 1 ½" inch steel angle if round pipe is used for the posts or 2 inch angle iron if 2" square tube is used for the posts. The top rail shall be welded to the posts at a height of 7 feet from ground level.

## **10.4 CHAIN LINK FENCE**

Chain link fencing shall be constructed according to project plans and specifications and shall conform to the following:

All materials shall be new and upon request of the Engineer, the Contractor shall furnish a certification of inspection stating that the materials have been manufactured, sampled and tested so as to meet the requirements of these specifications.

Posts, rails and braces shall be manufactured of hot-rolled steel strip in compliance with ASTM F-569 having minimum yield strength of 50,000 psi. The pipe shall be

manufactured by electric arc welded cold-formed process per ASTM A-669. The exterior shall be triple coated and the interior single coated per ASTM F-1234. The triple coated exterior surface shall be hot-dipped zinc coated (galvanized) having a weight of not less than 1.0 oz./square foot  $\pm 0.1$  oz. Posts shall be fitted with tops or extension rails as specified designed to fit securely over the post top providing suitable bearing length to securely support barbed wire where specified.

Chain link fabric shall conform to the requirements of ASTM A-392 (zinc coated) or ASTM A-491 (aluminum coated). The wire used in manufacture of the fabric shall be a minimum 9 gauge unless otherwise specified. The coating process shall leave the fabric completely free of barbs, snags, icicles or other projections, which might be hazardous.

Barbed wire shall be 4 point pattern; composed of 2 strands of 12½ gauge galvanized steel wire with barbs spaced 5 inches apart and shall conform to ASTM A-121.

Line posts shall be placed no further than 10 feet apart and firmly set in MAG Class "B" concrete footers not less than 12 inches in diameter and 18 inches in depth.

Corner and tension posts shall be firmly set in MAG Class "B" concrete footers not less than 18 inches in diameter and 30 inches in depth.

### **10.5 REGULAR DUTY PIPE-RAIL PERIMETER FENCE**

The regular duty pipe rail fence posts shall be 1 ½ inch diameter schedule 40 plain-end black steel pipe. The posts shall be placed no further than 10 feet apart and be firmly set in a concrete footer at least 10 inches in diameter and 18 inches deep. The posts shall extend 3 inches above the top rail. The exposed surface of the top of the post shall be ground smooth or have a bead welded completely around the circumference to eliminate any sharp edges.

Regular duty pipe rail fencing shall be constructed of ½ inch diameter black steel welded or seamless pipe with male ½ inch NPT male threads on both ends fastened together with ½ inch NPT female couplers. Dimensions and construction shall be as indicated in Standard Detail 014.

### **10.6 HEAVY DUTY PIPE-RAIL PERIMETER FENCE**

The heavy-duty pipe rail fence posts shall be 1 ½ inch diameter schedule 40 plain-end black steel pipe. The posts shall be placed no further than 10 feet apart and be firmly set in a concrete footer at least 10 inches in diameter and 18 inches deep. The posts shall extend 3 inches above the top rail. The exposed surface of the top of the post shall be ground smooth or have a bead welded completely around the circumference to eliminate any sharp edges.

Heavy-duty pipe rail fencing shall be constructed of  $\frac{3}{4}$  inch diameter black steel welded or seamless pipe with male  $\frac{3}{4}$  inch NPT male threads on both ends fastened together with  $\frac{3}{4}$  inch NPT female couplers. Dimensions and construction shall be as indicated in Standard Detail 015.

### **10.7 WILDLIFE CROSSING**

Wildlife crossings shall be constructed in wire fences wherever experience indicates that wildlife concentrates to cross the fences. Crossings shall be constructed so as to allow ingress and egress by targeted wildlife species without compromising the ability of the fence to prevent livestock crossing the fence as specified by the Engineer.

### **10.8 ELK JUMPS**

Elk jumps shall be constructed by enclosing the top wire of a standard livestock fence in 1 inch diameter black PVC or HDPE pipe.

### **10.9 WILDLIFE ESCAPE PASSAGES**

Wildlife escape passages shall be constructed in habitat restoration elk enclosure fences as required allowing movement of non-targeted wildlife through the fence. Escape passages for habitat restoration enclosures shall be limited to 18 inch X 18 inch square framed openings located adjacent (within 3 feet) to the corners of Elk enclosure fences. Openings shall be framed with 1 inch square steel tube or similar material at the discretion of the Engineer.

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## **SECTION 11 – PIPE AND FITTINGS**

### **11.1 GRUVLOK/VICTAULIC PIPE**

All 'GruvLok'/Victaulic type pipe and fittings furnished under these specifications shall conform to the following: American Society for Testing and Materials (ASTM) Specification F-1476, ASTM Specification C-606, ASTM Specification A-536, ASTM Specification A-47, ASTM Specification B-633 and ASTM Specification A-183, as applicable.

### **11.2 PVC PIPE**

All PVC pipe furnished under these specifications shall conform to the following: All PVC pipe, couplings and fittings shall be schedule 40 or 80 and be made from Class 1245-A or Class 1245-B compounds as defined and set forth in American Water Works Association (AWWA) Standards relating to PVC potable water distribution pipe. The PVC compounds used to manufacture said PVC pipe shall contain no

deleterious ingredient in any amount that has been demonstrated to migrate into water in detectable quantities. PVC pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. The pipe shall be uniform in color, opacity, density and other physical properties. Any gaskets and/or lubricants used with PVC pipes and couplings shall be manufactured from materials that are compatible with the plastic material and each other when used together. The materials shall not support the growth of bacteria or adversely affect the potable quality of the water to be transported.

Primer shall conform to ASTM F-656-80 and shall be purple in color.

Solvent-cement shall conform to ASTM D-2564 and shall be the proper type and viscosity according to pipe size. The solvent-cement shall be of a solution of Type 1, Grade 1 un-plasticized PVC resin. The cement shall be free flowing and shall not contain lumps, microscopic un-dissolved particles or any foreign matter that will adversely affect the ultimate joint strength. It shall show no stratification or separation that cannot be removed by stirring.

PVC pipe and fittings joined using the solvent-cement method shall be joined using a manufacturer approved primer solvent-cement joining system. Manufacturer's recommendations for joining under high temperature (over 100° F) and/or high humidity (over 60%) shall be strictly followed.

Fittings for PVC pipe may include tees, elbows, caps, plugs, adaptors, bushings, reducers, increasers and valves. Push-on, gasket type joints shall be constructed in accordance with the manufacturer's specifications.

The pipe shall be permanently marked indicating size and pressure rating. The appropriate markings shall occur on the pipe at least once in every 24 inches. The seal of approval or marking of the testing laboratory shall be included in the marking on all pipe intended for transporting potable water.

PVC pipe shall be handled in accordance with AWWA Guideline M23. PVC pipe shall not be handled with individual chains or single cables, even if padded. Pipe shall not be dropped to the ground or rolled into the trench. Pipe shall not be dropped or rolled against other objects. All PVC pipe, fittings and gaskets shall be stored covered so as to protect from exposure to sunlight, ozone and grease. PVC pipe shall be stored so as to not become deformed or bent during storage.

### **11.3 VALVES**

Valves shall be of the type, size and capacity designated on the plans or in the special provisions and shall comply with the requirements specified therein. All valves shall be capable of satisfactory performance at a working pressure of 150 psi. Valves shall be designed to permit disassembly to replace sealing components without removal of the valve body from the pipeline.

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## **SECTION 12 – SUPPORTS**

Pipe and tank supports shall be of the size and design as designated on the plans. Construction of any tank supports over 3 feet in height shall be constructed only after completion of an engineering design, prepared by an Engineer registered to practice in the State of Arizona with specialization in either Civil or Structural Engineering, the design shall include any geotechnical evaluations and/or borings the Engineer may deem necessary. Prior to construction, two copies of the design shall be provided to the Department Engineer for review and approval. Construction of such structure shall take place only under the direct supervision of the designing Engineer.

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## **SECTION 13 – CONCRETE**

Portland cement concrete shall be as described in the latest revision of the Maricopa Association of Governments Specification 725 and have a set strength of no less than 3500 psi.

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## **SECTION 14 – MEMBRANES**

### **14.1 LINERS**

Membrane liners may be utilized to prevent leakage from existing rigid tanks or to prevent leakage from earthen tanks at the discretion of the Engineer.

### **14.2 HYPALON/PVC/HDPE LINERS**

At the discretion of the Engineer, Hypalon, PVC or HDPE liners may be utilized to prevent leakage from either ridged walled or earthen tanks. The thickness of membranes to be utilized shall be as specified in the project documents and specific material specifications shall be subject to approval by the Engineer.

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## **SECTION 15 – BEDDING AND BACKFILL**

**SPECIAL NOTE: Bedding and backfill methods and materials for commercial products covered under this section are based on manufacturer's installation specifications under typical application conditions. They are provided such**

**that project designers can assure full compliance with product warranties should they desire to do so. However, under most circumstances when constructing wildlife waters at remote locations, compliance with these specifications is impractical and/or cost prohibitive. As such, the Department takes a site-by-site “best practice” approach to achieving bedding and backfill applications that will result in adequate structural support and reduce the potential for long term damage to critical components of the development. Specifications for this approach are as follows:**

Bedding: Bedding thickness shall comply with manufacturer’s recommendations. All cobbles and angular material shall be manually removed to the satisfaction of the Department Engineer or his designee. In severely coarse materials, screening may be necessary, at the discretion of the Department Engineer or his designee.

Backfill: Effort shall be made to use backfill material as free of cobbles and angular material as possible. When mechanical backfilling is used, “observer(s)” shall be present to observe backfill operations and displace any cobbles or angular rock that lodges immediately against a component installation. Backfill material shall be carefully placed in lifts and worked around tanks or pipe until one foot of cover is achieved. Remaining backfill may be applied with no further restrictions. Backfill should, at a minimum, exceed natural grade by 6 inches to 12 inches to allow for settlement.

### **15.1 ROTATIONALLY MOLDED POLYETHYLENE TANKS**

The tank(s) shall be placed on a ¾ inch thick rubber mat on a dirt pad that has been compacted, smoothed and leveled.

### **15.2 PVC “PIPE” TANKS**

Backfill materials shall be either pea gravel having a minimum diameter of 1/8 inch and a maximum diameter of ¾ inch or crushed stone consisting of a mix of particles between 1/8 inch and ½ inch meeting ASTM Specification C-33 paragraph 9.1.

The tank(s) shall be placed on a smooth leveled bed of backfill material 1 foot in depth. Two lifts of backfill materials shall be carefully placed in lifts not exceeding 1 foot in depth and carefully worked under the tank haunches using a non-metallic probe. After placement of the second lift, the tank may be backfilled to 1 foot above the top of the tank using native materials free of any deleterious materials or stones over ¾ inch in diameter. The remainder of the tank pit shall then be backfilled with either native or imported granular material.

### **15.3 PIPELINES**

Pipelines shall be bedded on either selected native material, free of all deleterious materials and stones over ¼ inch in diameter or imported sand up to 1/3 of the pipe

diameter. Pipelines shall then be backfilled to at least 3 inches above the top of the pipe with selected native material, free of all deleterious materials and stones over  $\frac{3}{4}$  inch in diameter. The remainder of the pipe trench shall then be backfilled with either native or imported granular material.

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## **SECTION 17 – EVAPORATION COVERS**

Evaporation covers shall be constructed in accordance with individual project special provisions and details. Such covers shall be constructed from closed-cell polyurethane foam, high-density polyethylene membrane, Hypalon and polypropylene rope or other materials as shown in the details.

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## **SECTION 18 – MISCELLANEOUS APPURTENANCES**

### **18.1 GUTTERS**

Gutters shall be manufactured of polyethylene and by manufactured by Rainmaker Wildlife or an approved equivalent. The general dimensions for this gutter are indicated on the drawings.

The two gutter halves shall be glued together using Lexel® caulk or an approved equivalent. Three (3)  $\frac{1}{4}$  inch diameter zinc-coated bolts that are 1  $\frac{1}{2}$  inches long with fender washers and nylon lock nuts, shall be used on each side of gutter to secure in place while the caulk dries and shall stay in place after caulk dries. At least six (6) bolts, washers, and nuts shall be used to complete the entire gutter assembly. There should be no bolts, washers, or nuts used on the bottom of the gutter.

Design parameters: The gutter extension is used to collect rainwater at the end of an artificial watershed. The water then recharges the storage tanks via at least two or more feed lines.

### **18.2 FLOAT ASSEMBLIES**

Float assemblies shall be constructed entirely of corrosion resistant stainless steel, copper, brass and bronze. No ferrous metals shall be permitted in any float valve installation.

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## **SECTION 19 – CAMOUFLAGE AND FINISHES**

### **19.1 ARTIFICIAL “ROCK” PANELS**

#### **19.1.1 ARTIFICIAL “ROCK” PANELS-CONCRETE**

Artificial rock panels to be obtained from manufacturer experienced in creating zoo or museum exhibits and approved by Department. Panels will be fabricated from molds taken of natural rock formations, the pattern/type matching geology of the specific project site and approved by Department. Concrete used in each panel shall have an integral base color (from an organic pigment) similar to rock formations at project site. Panels shall be a minimum of ½ inch thickness with integrated reinforcement fibers or other reinforcement material. No rock panel may weigh more than 300 pounds, and measure more than 4 feet in width or height. Each panel will have fasteners (galvanized wire, zip ties) integrated into the backside to facilitate attachment to the supporting rebar frame.

Rock panels will be arranged and assembled to imitate nearby natural geological formations to hide water development components. Intersections or meeting points of panels will be seamed with mortar mixture or fiberglass. Seams will blend with the texture, color, and shape of adjoining panels. Large gaps or meeting points will be reinforced and/or filled with wire mesh and coated to the thickness of adjoining panels. Concrete adhesive/bonder will be applied to both sides of the seam.

An armature of rebar, tubing, or pipe will be erected, and properly anchored, to support the panels so that the weight of the panels will not bear on the water development components (e.g. tank, trough or apron). Intersections of the steel frame may be welded or tied.

#### **19.1.2 ARTIFICIAL “ROCK”- CAST-IN-PLACE**

Casting artificial rock in situ may also simulate artificial geological formations. An armature of rebar, tubing, or pipe will be erected, and properly anchored, to support the concrete so that excessive weight is not bearing on the water development components (e.g. tank, trough, apron). Intersections between two pieces of steel armature may be welded or tied. The armature shall be designed, shaped, and built to simulate the surrounding geological formations nearby.

The backside of the rockwork, the side not visible to the eye, shall have stucco lath (175 or heavier) attached to the armature to provide strength, protect the components, and reduce concrete waste. The front side of the armature shall have 1 inch galvanized chicken wire attached and be completely integrated into subsequent cement layers. Wire lath and stucco mesh may be attached with hog rings, tie wire,

zip ties, or other fasteners provided that all exterior surfaces shall be covered with a minimum of ½ inch of cement material.

Cement mixture formula shall be the same as that for a rich block laying mortar. It may be hand applied or spray on, in a minimum of two layers. No portion of the infrastructure or fasteners will be exposed, with at least ½ inch of material. A minimum of two layers will be applied, achieving a final minimum thickness of ¾ inch. If more than 7 days passes between applications of coats, concrete adhesive or bonder will be applied to the underlying surface. While fresh and pliable the cement material will be molded, sculpted colored and textured to simulate the surrounding geology to the satisfaction of the Engineer.

### 19.1.3 ARTIFICIAL FIBERGLASS “ROCK” PANELS

Artificial rock panels to be obtained from manufacturer experienced in creating zoo or museum exhibits and approved by Department. Panels will be fabricated from molds taken of natural rock formations, the pattern/type matching geology of the specific project site and approved by Department. Fiberglass material of each panel will have an integral base color similar to rock formations at project site. Panels are a minimum of 3/8 inch thickness of fiberglass, with integral reinforcement fibers or other reinforcement material. Each panel will have fasteners (galvanized wire, zip ties) integrated into the backside to facilitate attachment to the supporting rebar armature.

Rock panels will be arranged and assembled to imitate nearby natural geological formations, to hide water development components. Intersections or meeting points of panels will be seamed with fiberglass mat and resin, the same thickness of adjoining panels. Seams will blend with the texture, color, and shape of adjoining panels. Large gaps or meeting points will be reinforced and/or filled with mesh, or other material, and coated to the thickness of adjoining panels.

An armature of rebar, tubing, or pipe will be erected, and properly anchored, to support the panels so that the weight of the panels will not bear on the water development components (e.g. tank, trough or apron). Intersections of the steel frame may be welded or tied.

## 19.2 PAINTS

Paint shall be high-quality exterior grade flat latex. Colors, basic painting pattern, and percentage shall be determined by the Department representative at the individual project site.

All surfaces must be cured, clean, and dry. Paint may be thinned with water up to ½ pint per gallon to maintain good flow and workability.

Differing colors of paint shall be applied while preceding layer is still fresh, to facilitate blending between colors. Paint may be applied by brush, roller, or airless sprayer as required.

Follow all manufacturer specifications.

### **19.3 CONCRETE STAINS**

Concrete rock panels or cast in place, may be colored/stained use acidic stains designed for that purpose. Preferred product is Lithochrome® however; other products may be reviewed and approved by the Department. The color(s), stain pattern and percent coverage to be determined by the Department.

Concrete should be sufficiently cured, at least 14 days, before applying. Surrounding rocks and vegetation protected from over spray or contact. Staining will be applied in two coats, with at least 24 hours between applications. After the final application has cured for 4 hours, wash coated surfaces with a solution of baking soda and water (1 lb. sodium bicarbonate per 5 gallons water).

The Contractor shall follow all manufacture's specifications and government guidelines, and utilize appropriate suitable personal protective equipment.

### **19.4 BLOCK FACING**

In some applications, the use of cinder or concrete block will be specified as retaining or protective walls. Any exposed surfaces of the block will require texturing to match surrounding natural surfaces. This texturing can be accomplished by the application of colored plasters, stuccos or mortars. Split-faced block is also acceptable to attain the desired appearance. Before installing, a material sample and manufacturer's name will be submitted to the Department for approval.

## APPENDIX A – ENGINEERING POLICY



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### **G3.1 Engineering Services**

*Effective Date: 10/09/2012*

*Policy Process Owner: Development Branch Chief*

**Department Policy:** Under the direction of the Chief Engineer (CE) the Engineering Section (ES) is responsible for providing project delivery management for all construction activities involving the development or preservation of the Department's real property and infrastructure assets, and ensuring compliance with fiscal and scheduling commitments. ES shall also establish design standards for all public works partnership projects in which the Department has a material interest. Additionally, upon request, ES will provide technical assistance to all work units in the areas of civil, environmental, geotechnical and structural engineering, plus surveying, hydrology, and architectural services. Based on the need for specialized technical competencies, it may be the ES's assessment to outsource and administer professional consulting services.

#### **Definitions**

**Building System:** The aggregate of components which contribute to the overall function of a building and related property such as flooring, plumbing, HVAC, electrical components, fire prevention, pavement, concrete flatwork, structural components, roofing, interior/exterior finishes, wells, wastewater systems, etc.

**Capital Improvement Project:** A project category that includes new construction or major improvements to facilities and infrastructure that increases the value of the location or results in an increase in capacity or useful functionality of the facility.

**Cyclic Maintenance:** Cyclic maintenance is the scheduled replacement or renovation of major building system components based on their individual life expectancy, which will preserve the overall value of the asset, circumvent costly repairs or maintain an established level of suitable function and appearance.

**Deferred Maintenance:** Cyclic Maintenance items and required replacements not accomplished within a recommended time-frame due to funding constraints or other considerations.

**Emergency Maintenance and Repairs:**

Unscheduled and unanticipated building system or equipment repairs requiring immediate response in

order to maintain functionality of essential facilities and infrastructure.

**Corrective Maintenance:** These maintenance activities are typically related to health, safety or accessibility concerns as determined by the Department's Loss Prevention Coordinator or ES staff, and require a timely response.

**Principal Facilities:** Mission critical building systems and infrastructure necessary to support the day to day operations of the department, which include the state headquarters, regional offices, fish hatcheries, shooting ranges, actively managed wildlife areas, dams, recreational facilities and other department assets that encounter frequent human interface.

**Project Proponent:** A Department staff member, who is a project's primary advocate and point of contact from inception through completion. The project proponent is responsible for directing project-related information to the ES.

**Project Management:** The discipline of planning, organizing, and managing resources to bring about the successful completion of specific project goals and objectives within the constraints of time, cost, and performance requirements.

**Public Works Partnership:** Any construction project supported by a combination of various public resources or public and private resources for the benefit or use of the general public.

**Public Works Project:** Any construction project supported by public resources for the benefit or use of the general public.

**Technical Review:** A peer review process which applies professional experience and knowledge in the evaluation of project plans, specifications and supporting documentation to determine compliance with acceptable design practices and assure project objectives are met in an efficient and cost effective manner.

**Roles and Responsibilities:** ES is charged with providing the oversight required to ensure that capital projects implemented by the Department meet professional design, engineering and construction practices and comply with standard specifications, applicable building codes, local ordinances and federal guidelines including the Americans with Disabilities Act (ADA). Within its role in the project management process ES is responsible for implementing and monitoring appropriate quality control measures to assure desired outcomes. The CE is responsible for monitoring and updating the architectural and



structural barrier components of the Department's Condition Assessment Plan in compliance with Title II of the ADA. ES also provides Department-wide technical support for programmatic projects requiring engineering, surveying, architectural, or construction management services. ES will establish design standards for all public works partnerships involving the commitment of Department resources toward the construction of projects pursued through agreements with government agencies, non-governmental organizations or private parties. As part of its review and sign-off on the Department's Environmental Assessment Checklist process (EAC), ES shall identify engineering compliance requirements for public works and public works partnership projects. Project proponents must include the Department's engineering compliance requirements in all public works partnership agreements. Additionally, ES inspection of final construction must be completed and documented before a facility is opened for public use.

**Project Delivery Process and Management:** ES shall facilitate a continuous, systematic approach of identifying, assessing, prioritizing and implementing capital improvements, cyclic maintenance, repairs or replacement requirements for its principal facility and infrastructure assets as determined through the following processes:

A. **Capital Improvements:** Proposals for projects under this category shall be submitted on an annual basis to the DBC by the proponent's Leadership Team member. ES may participate in the proposal process with recommendations coordinated with other work units. Engineering support will be available to all work units to assist with developing project proposals, specifically in determining feasibility of alternatives and generating budgetary cost estimates. Final project proposals will be submitted to Executive Staff (E-Staff) by the Budget Control Development Supervisor during the appropriate budget cycle process. Funding and project priorities are determined at the agency level and will include input and recommendations from Lands Council. Any proposed changes to established priorities and funding must be submitted to E-Staff through the Chief Financial Officer (CFO).

**Note:** Based on project specific risk and liability implications and/or the need for specialized technical competencies, it may be

ES's preference to outsource professional design services for capital projects that will result in extensive public interface. The decision to outsource such services shall be made by the Development Branch Chief (DBC) in consultation with the CE.

B. **Cyclic Maintenance:** ES will administer a Condition Assessment Program (CAP) employing a data driven approach to effectively identify, prioritize and schedule specific maintenance, repair, renewal and replacement requirements that extend the life and retain the usable condition of the Department's principal facilities and associated infrastructure. CAP will establish a comparative benchmark and condition index to indicate the relative physical condition of a facility as well as developing cost data for use in the Department's capital budget development process. CAP information will be accessible Department-wide through various reporting mechanisms within the enterprise data management system. The CAP process will include architectural barrier surveys to evaluate public access to Department activities and programs for compliance with current ADA Standards for Accessible Design. Condition Assessments for principal facilities will be updated every two years by ES in coordination with the associated property stewards. A five-year Facilities Maintenance Plan maintained by ES will identify cost and recommended scheduling of required maintenance. ES will brief E-Staff on recommended priorities and funding allocation at the beginning of each fiscal budget cycle and will include recommendations submitted by Lands Council. E-Staff will review and approve final project priorities and funding. ES will provide E-Staff a mid-year briefing to establish whether projects are tracking satisfactorily or to adjust priorities if necessary. Any proposed changes to established priorities and funding must be submitted to E-Staff through the CFO.

C. **Public Works Partnerships:** During implementation of public works partnership projects, the project proponent shall ensure compliance with established design standards. Engineering support can be coordinated directly with the CE. ES and the project proponent will use a backward planning strategy to derive a mutually agreed upon timeline for incorporation into the project planning schedule. It will be the project proponent's responsibility to supply



necessary plans, specifications, reports, etc. and pertinent contacts to conduct an adequate review. A final inspection and approval of construction by ES shall be included as a provision in all agreements where Department resources are expended.

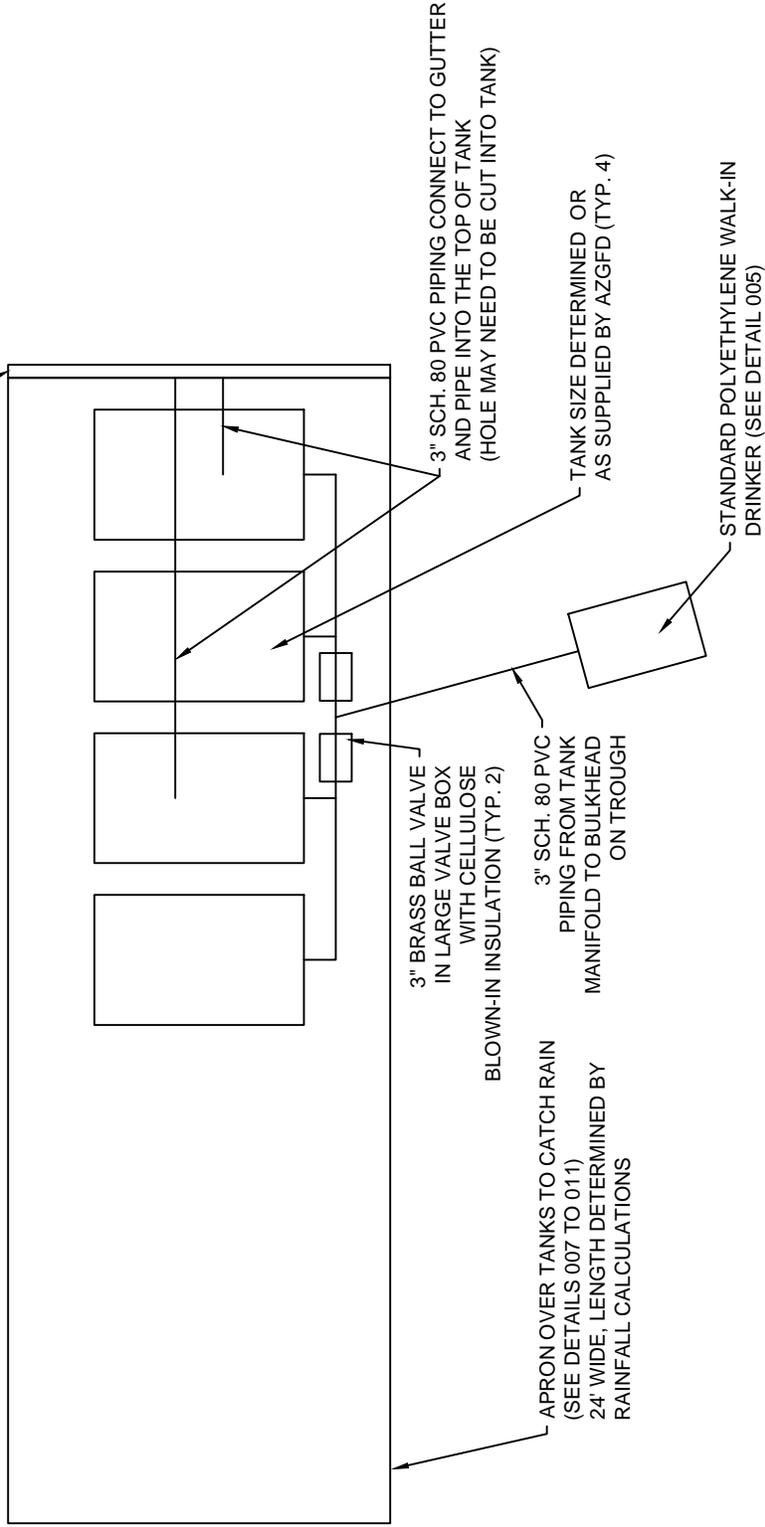
- D. **Preventive Maintenance:** Scheduling and oversight of routine servicing, repairs and inspections that aid in achieving the expected life cycle of a facility or associated equipment will be the responsibility of the individual facility managers with the exception of the six Regional Offices. ES will assist the Regional Offices in developing and administering their preventive maintenance programs as needed. Funding for routine preventive maintenance will be established in the annual operational budget for each facility.
- E. **Corrective Maintenance:** Routine action items identified by the Department's Loss Prevention Coordinator or ES will typically be the responsibility of the corresponding work unit. However, health safety items, requiring immediate engineering support will be coordinated directly through the CE or designated staff. ES shall review all health and safety inspection reports with the Loss Prevention Coordinator to determine where ES support is needed. Corrective maintenance or repair projects may be managed under the oversight of the corresponding facility manager or regional assistant.
- F. **Emergency Maintenance and Repairs:** Unplanned maintenance and repair projects will be assessed and managed by ES in cooperation with any affected work unit and/or facilities managers. Individual work units will be responsible for funding any single repair or maintenance action of \$500 or less. A funding allowance for emergency maintenance and repairs will be established in the annual operational budget for each facility. Funding sources for major maintenance and repairs will be determined by the DBC or CE.
- G. **Ongoing Technical Assistance:** ES is available to provide technical assistance in the areas of civil, environmental, geotechnical and structural engineering, plus surveying, hydrology, and architectural services, directly or through administration of professional consulting service contracts. Initial consultation regarding assistance can be made with the CE. Depending on projected scope and time

requirements, technical assistance requests may require the Project Proponent to submit a **Project Proposal Form**, found on the Intranet under Development and Engineering, for staffing assignment.

## Index of Drawings

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| 024        | SUN SHADE  | 11/7/14 |
| 025        | 38" REGION 4 WALK-IN TROUGH                      | 11/7/14 |

STANDARD GUTTER (SEE DETAIL 012)

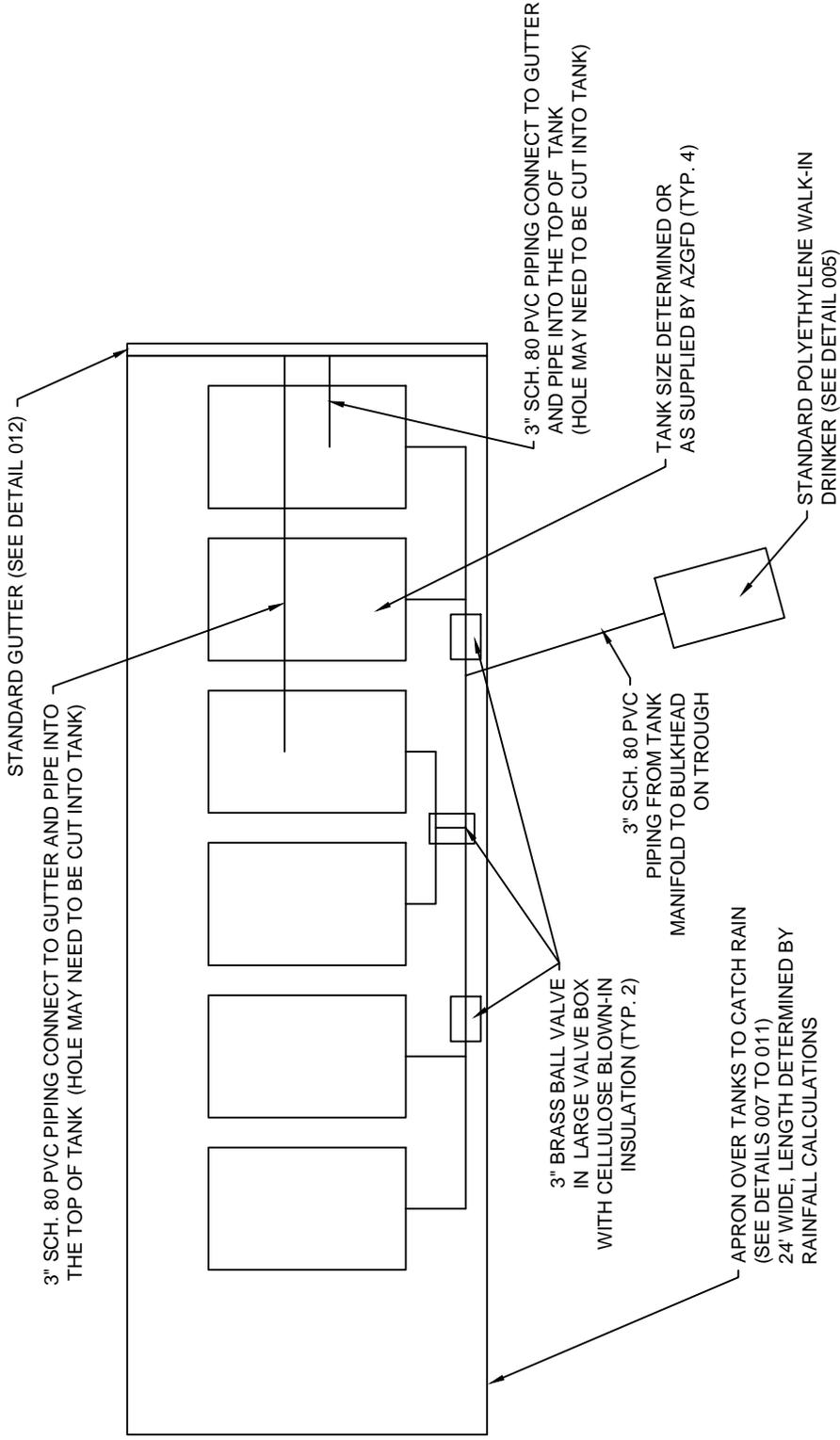


NOTES:

- 1) PLACE FOUR (4)  $\frac{3}{4}$ " THICK RUBBER MATS UNDER EACH TANK AND 1 AND A THIRD  $\frac{3}{4}$ " THICK RUBBER MATS UNDER EACH WALK-IN DRINKER

|      |           |            |          |
|------|-----------|------------|----------|
| BY:  | DATE:     | DETAIL NO. | REV. NO. |
| C.G. | 1/17/2014 | 001        | 1        |

TITLE: WATER CATCHMENT (FOUR TANK) PLAN VIEW



**NOTES:**

- 1) PLACE FOUR(4)  $\frac{3}{4}$ " THICK RUBBER MATS UNDER EACH TANK AND 1 AND A THIRD  $\frac{3}{4}$ " THICK RUBBER MATS UNDER EACH WALK-IN DRINKER

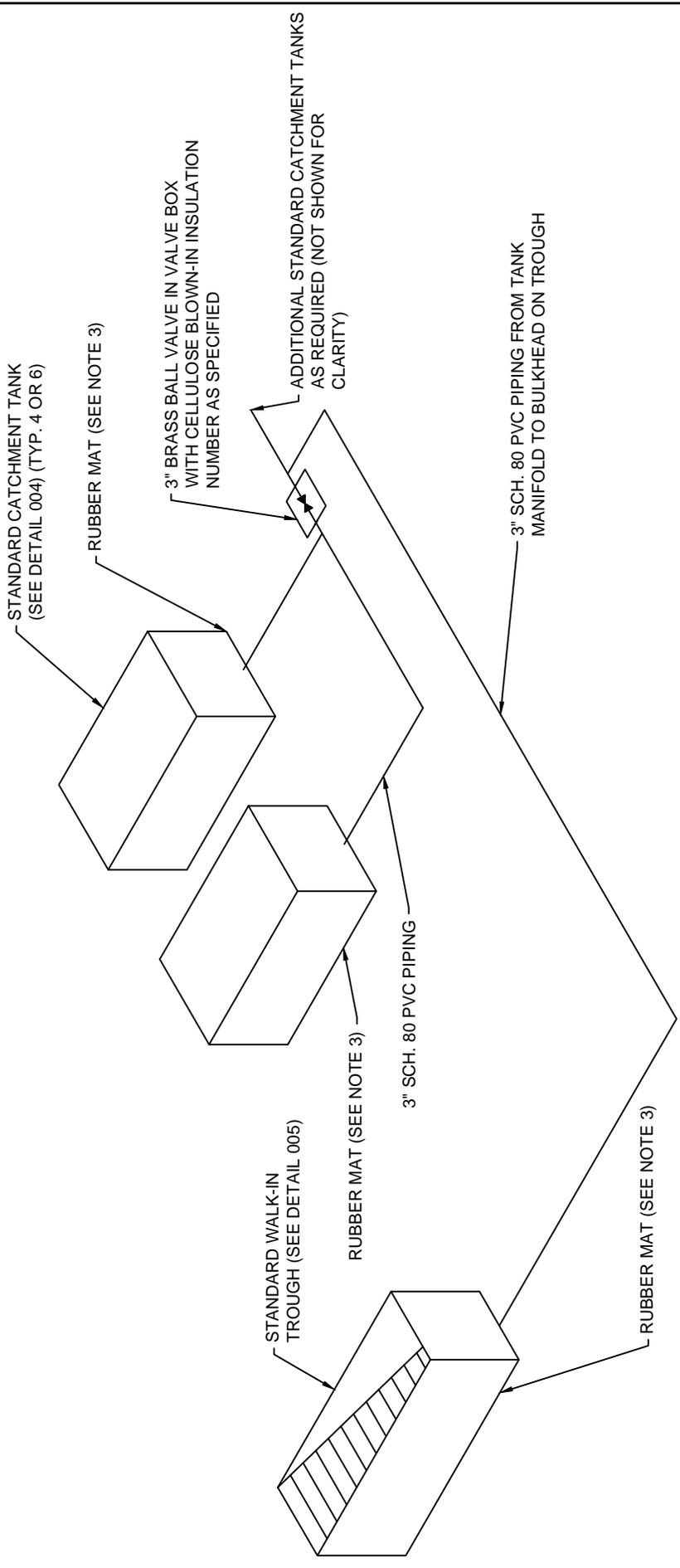
BY: C.G.

DATE: 11/7/2014

DETAIL NO. 002

REV. NO. 1

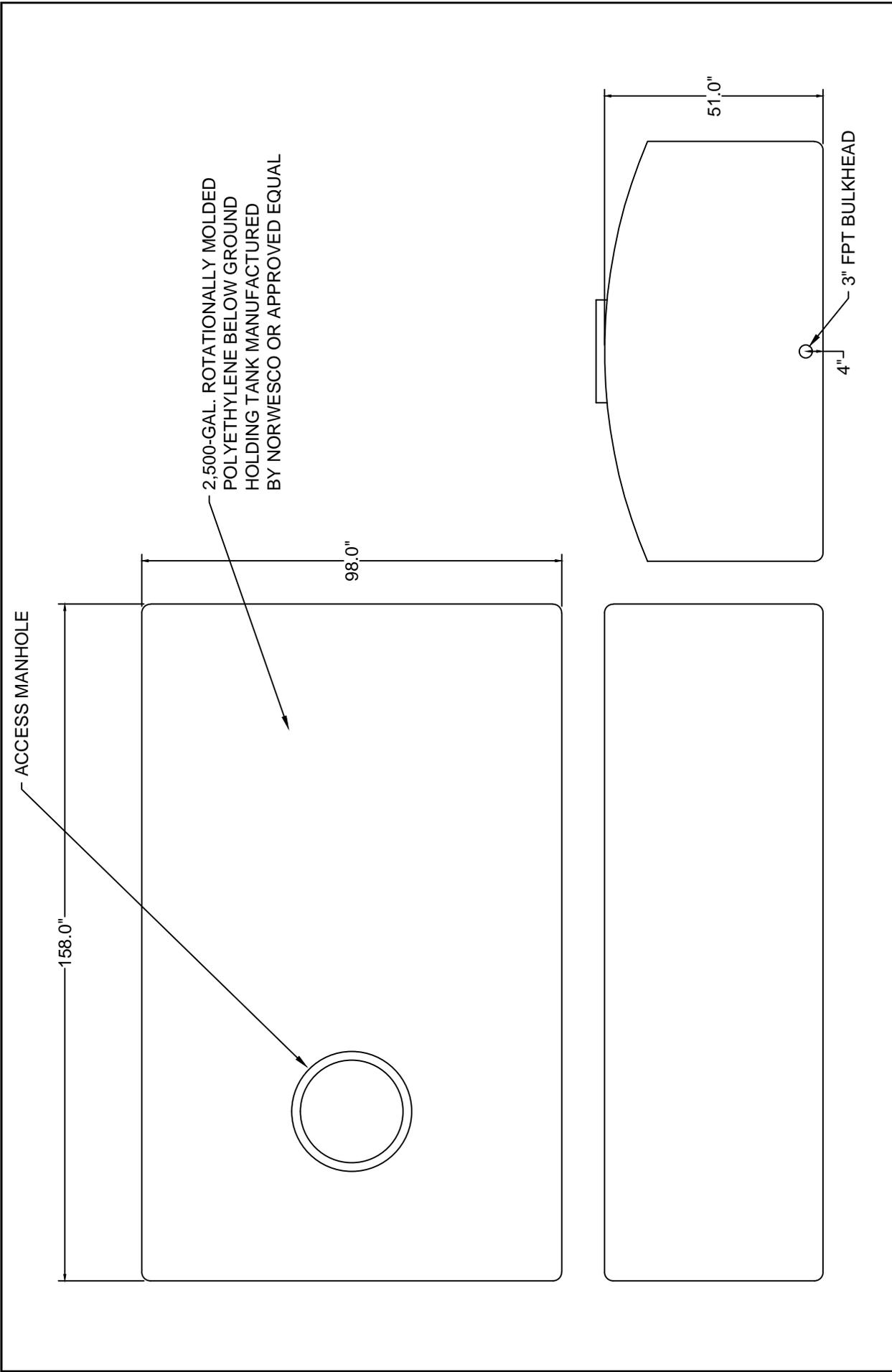
TITLE: WATER CATCHMENT (SIX TANK) PLAN VIEW



- NOTES:**
- 1) APRON, GUTTER, AND PIPING FROM GUTTER TO TANK NOT SHOWN FOR CLARITY
  - 2) USE TEFLON PIPE TAPE ON ALL SCREWED JOINTS
  - 3) PLACE FOUR(4)  $\frac{3}{4}$ " THICK RUBBER MATS UNDER EACH TANK AND 1 AND A THIRD  $\frac{2}{3}$ " THICK RUBBER MATS UNDER EACH WALK-IN DRINKER

NOT DRAWN TO SCALE

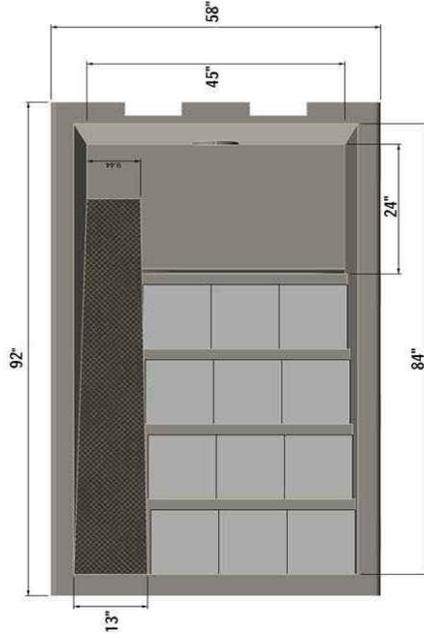
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| BY:<br>C.G.                       | DATE:<br>11/7/2014 | DETAIL NO.<br>003 | REV. NO.<br>1 |
| TITLE:<br>TANK PLUMBING ISOMETRIC |                    |                   |               |



NOTES:  
 1. TANK INSTALLED SHALL BE AS SPECIFIED OR AS SUPPLIED BY ARIZONA GAME AND FISH

|  |           |            |          |
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| BY:                                    | DATE:     | DETAIL NO. | REV. NO. |
| C.G.                                   | 11/7/2014 | 004        | 1        |
| TITLE: TYPICAL STANDARD CATCHMENT TANK |           |            |          |

April 9th, 2014

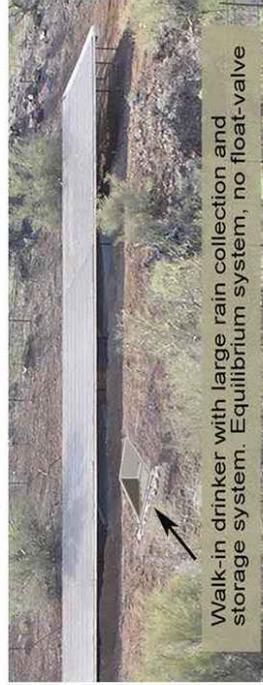


### New Walk-In Drinker For Large Capacity Wildlife Water Systems

Create a high capacity watering system for elk, big horned sheep and deer. The new "Walk-In" drinker gives animals easy access to water at any level by steps or ramp. The drinker and storage tanks are commonly set up as an equilibrium gravity feed system for simplicity and dependability.

The Walk-in drinker is made of extra thick polyethylene in a double-wall construction. Sidewalls and floor are stiffened with internal stringers and structural foam for a solid feel. Steps accept commonly available 12" cement pavers (not included in shipment). 3" bulkhead fitting included.

See additional details and pictures at .....[www.RainmakerWildlife.com](http://www.RainmakerWildlife.com)



Walk-in drinker with large rain collection and storage system. Equilibrium system, no float-valve

Rainmaker Wildlife  
PO Box 31697  
Bellingham WA 98228  
360-739-6361  
tim@rainmakerwildlife.com  
www.RainmakerWildlife.com

**Model:** Walk-in Drinker  
**Material:** LLDPE Polyethylene with UV Inhibitors  
**Capacity:** 400 Gallon Tank Capacity Dimensions: 92" x 58" x 44" H  
**Weight:** 530 lbs.(Partial Fill Structural Foam & Stiffening Stringers)  
**Fittings:** 3" PVC Line-in Bulkhead Fitting with Female Thread  
**Steps:** Accepts Common 12" Cement Pavers (not included)



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| BY:  | DATE:    | DETAIL NO. | REV. NO. |
| C.G. | 1/7/2014 | 005        | 1        |

TITLE: STANDARD POLYETHYLENE WALK-IN DRINKER

# Drinker-110

Drinker-110 provides water for deer, elk and other large animals at a comfortable 20" height. Can be installed above ground or in-ground. Includes high quality float valve system that is protected under the ramp and accessible through the hatch. Durable double wall construction and built-in escape ramp.



- Specifications;**
- 54" x 30" x 20"
- Capacity 110 Gallons
- Includes Float Valve System (Available without)
- Made of Polyethylene, Double-Wall Construction
- Built-in Escape Ramp
- Weight 77 Lbs
- Install Above Ground or In-Ground
- Drain Plug and 1" Threaded Pipe Fitting for Line-In Hatch for Easy Inspection Without Removing Top



Internal Float Valve System      1" Drain and 1" Line-In Fitting

Revised Jan 2014



Rainmaker Products LLC  
PO Box 31697, Bellingham WA 98228  
360-739-6361    [tim@RainmakerWildlife.com](mailto:tim@RainmakerWildlife.com)  
[www.RainmakerWildlife.com](http://www.RainmakerWildlife.com)

- Model: Drinker-110
- Material: LLD Polyethylene with UV Inhibitors
- Capacity: 110 Gallons
- Weight: 77 lbs
- Fittings: 1" Drain Plug, 1" Line-in. Float Valve System

Rainmaker Drinkers are designed to be supplied by a water line-in but can also be used as a small guzzler with a supplemental rain collections system. Collection size is dependant upon your rain zone. Please consult your local NRCS or Fish & Wildlife office for any requirements. Collector designs available at [RainmakerWildlife.com](http://RainmakerWildlife.com)

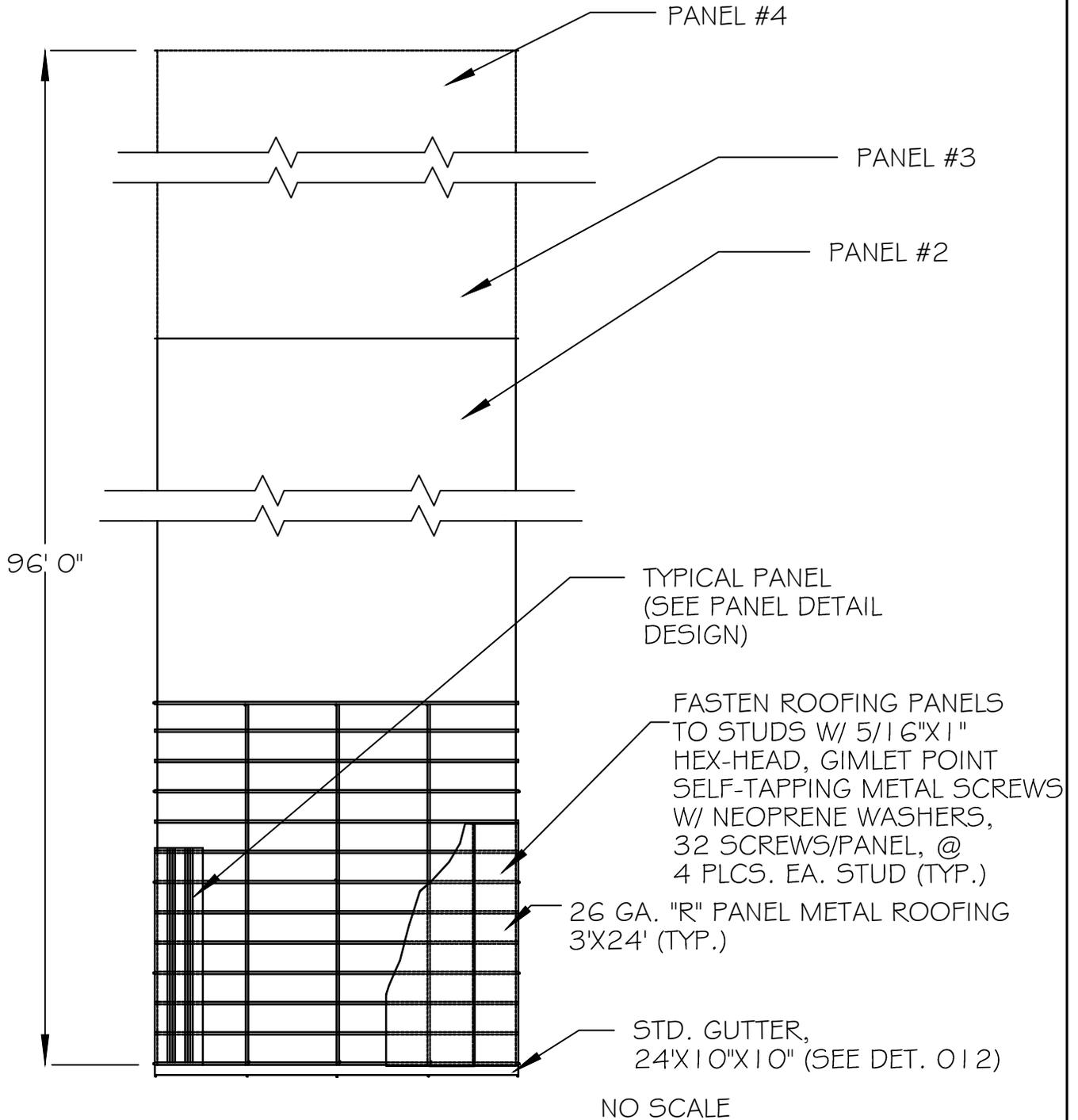
NOTE: NOT PART OF TYPICAL CATCHMENT. WILL BE SPECIFIED WHERE REQUIRED.

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| BY:  | DATE:     | DETAIL NO. | REV. NO. |
| C.G. | 11/7/2014 | 006        | 1        |

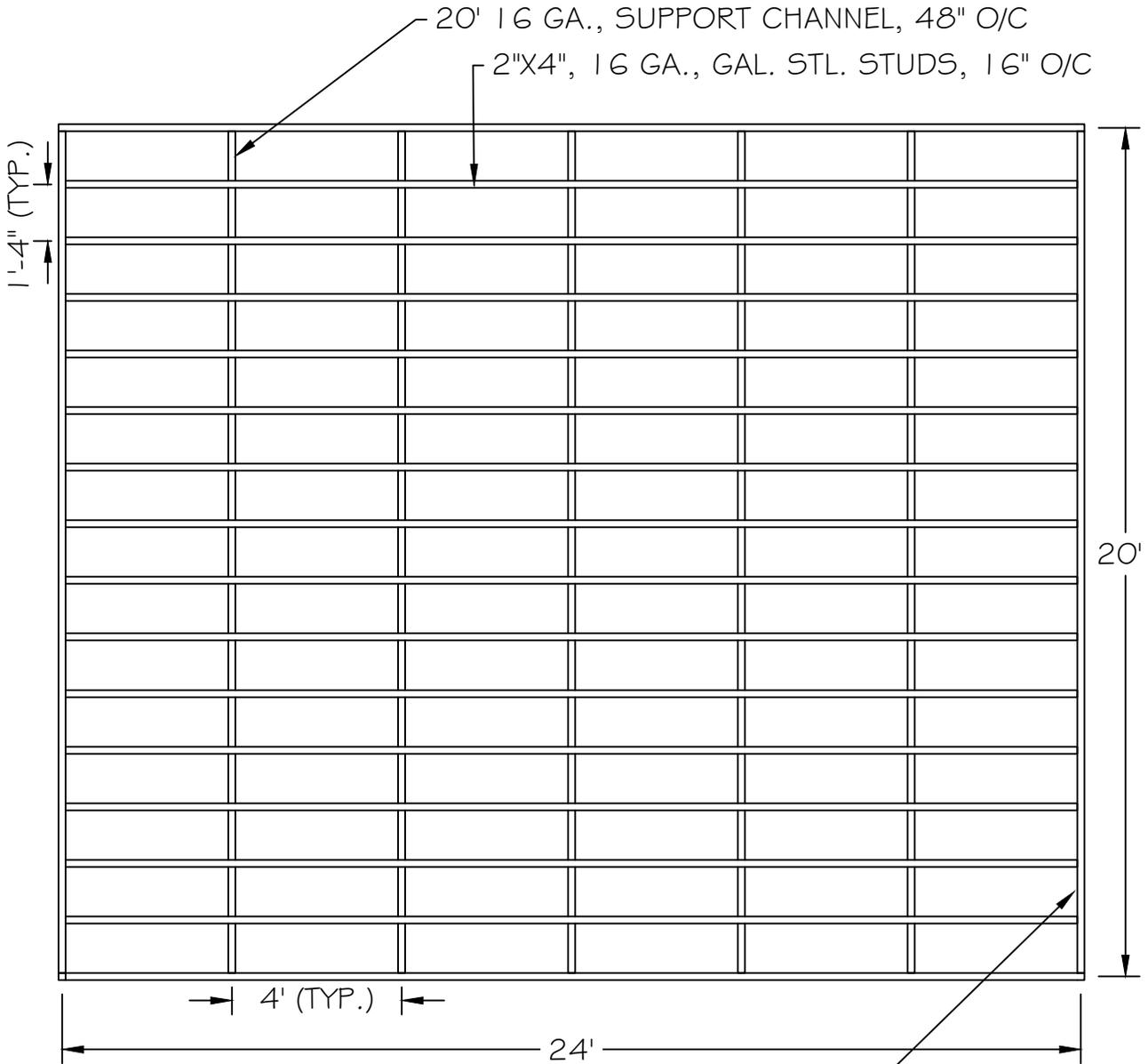
TITLE: STANDARD POLYETHYLENE FLOAT VALVE DRINKER

NOTE:

COMPLETE APRON CONSISTS OF MULTIPLE PANELS FASTENED  
 END TO END WITH A SINGLE STANDARD GUTTER ATTACHED ON ONE END.  
 ROOFING PANELS SHALL BE LAID CONTINUOUSLY ACROSS PANELS.  
 APRON GRADE SHALL BE SET TO FALL TO GUTTER. AS AN ALTERNATE,  
 APRON MAY BE CONSTRUCTED AS A 48'X48' SQUARE WITH  
 DOUBLE GUTTERS PLACED ALONG THE LOW SIDE.

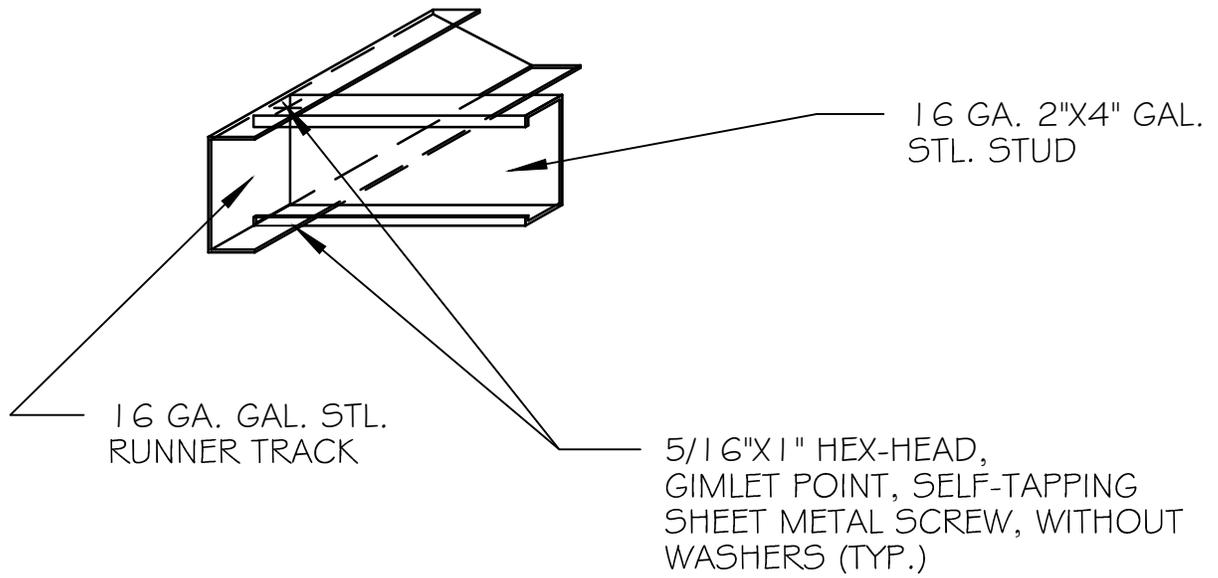


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| BY:<br>C.G.                    | DATE:<br>11/7/2014 | DETAIL NO.<br>007 | REV. NO.<br>1 |
| TITLE<br>STANDARD APRON LAYOUT |                    |                   |               |

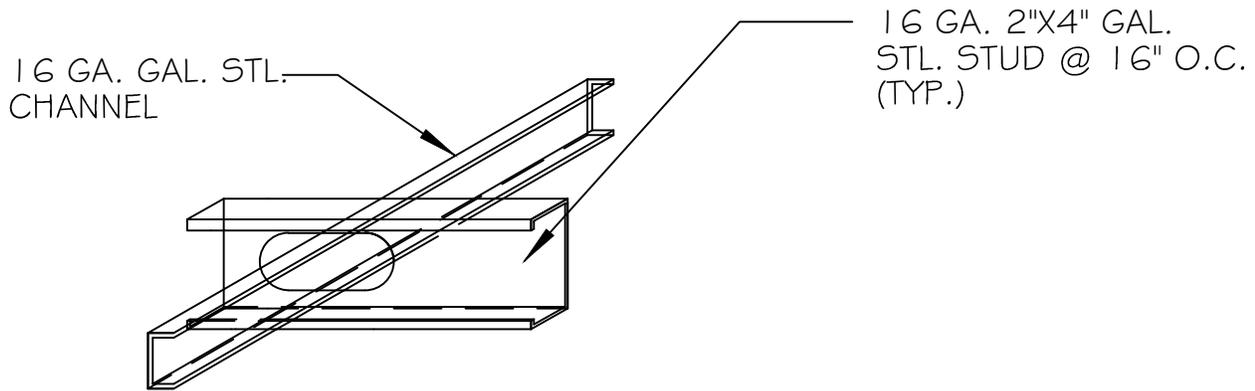


2"X4" GAL. STL. TRACK  
(SEE DETAIL 114)

|                               |           |            |          |
|-------------------------------|-----------|------------|----------|
| BY:                           | DATE:     | DETAIL NO. | REV. NO. |
| CBG                           | 11/7/2014 | 008        |          |
| TITLE<br>STANDARD APRON PANEL |           |            |          |

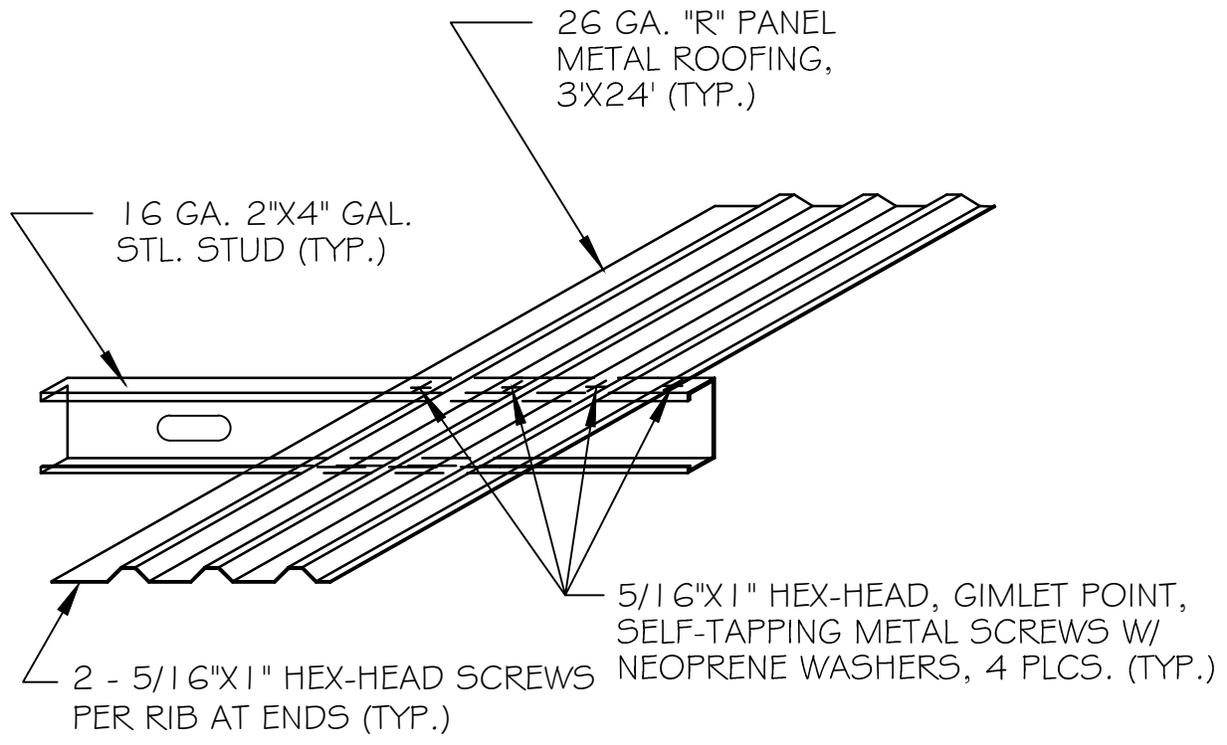


## STUD TO TRACK FASTENING DETAIL

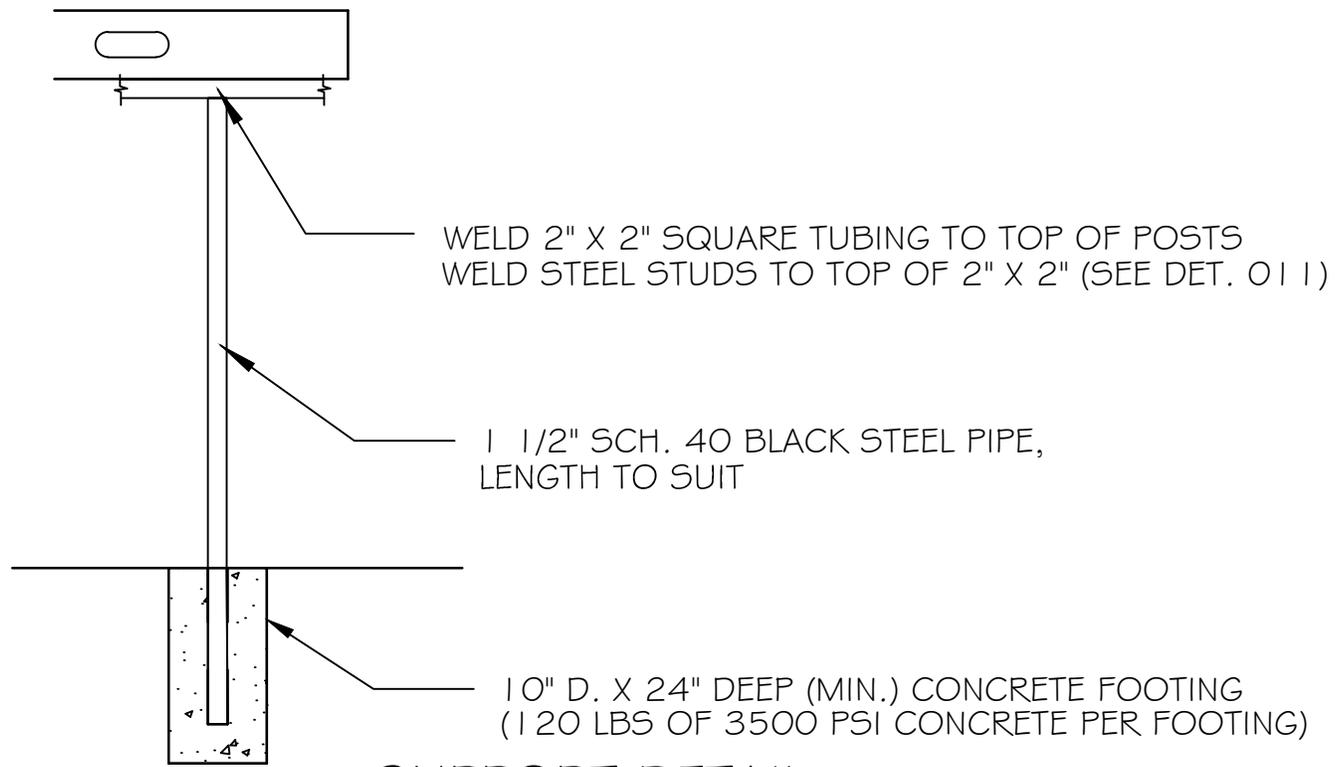


## STUD TO CHANNEL FASTENING DETAIL

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| BY:  | DATE:     | DETAIL NO. | REV. NO. |
| C.G.   | 11/7/2014 | 009        | 1        |
| TITLE<br>STANDARD APRON CONSTRUCTION DETAILS - 1 |           |            |          |



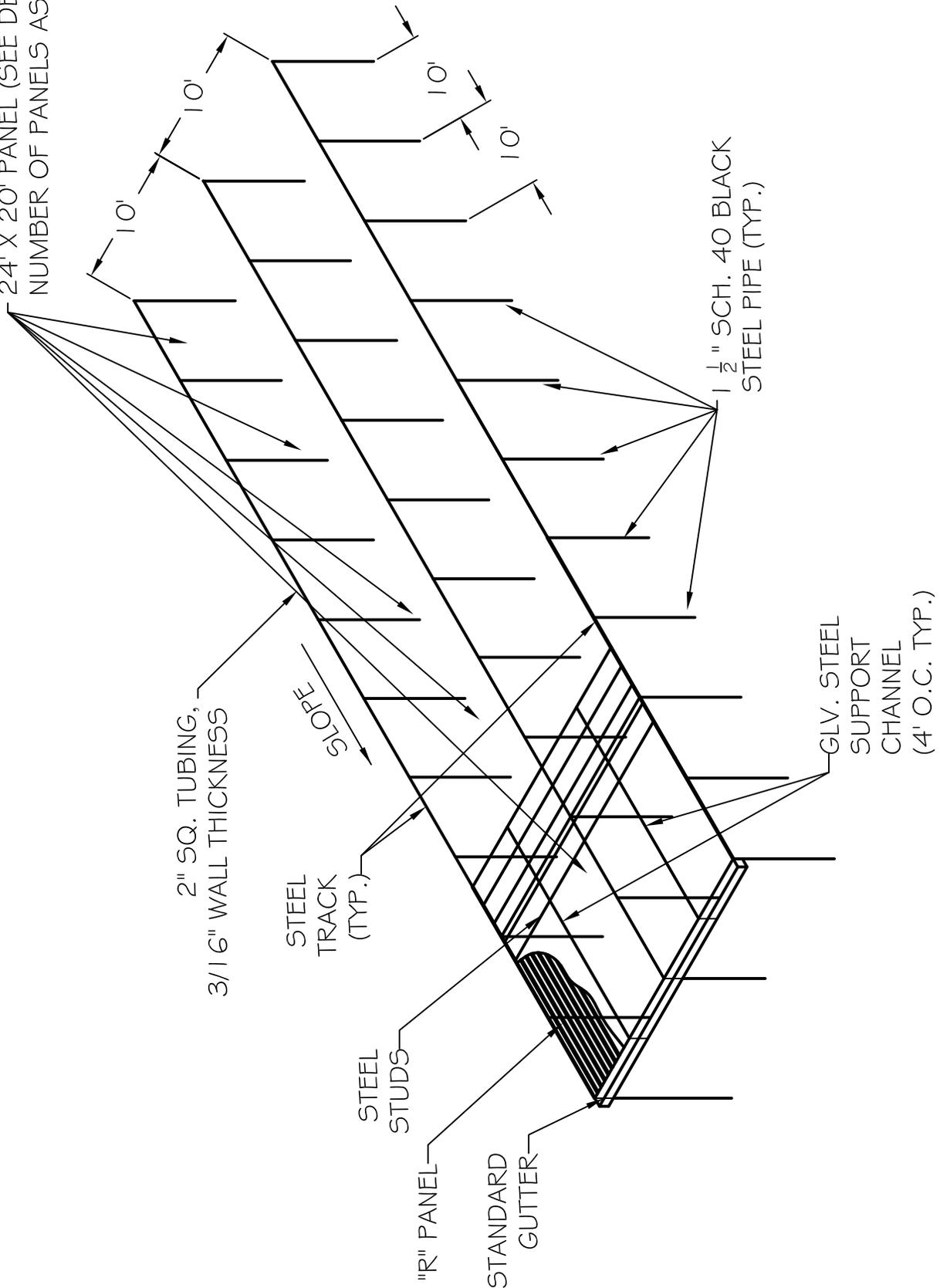
### APRON PANEL ATTACHMENT DETAIL



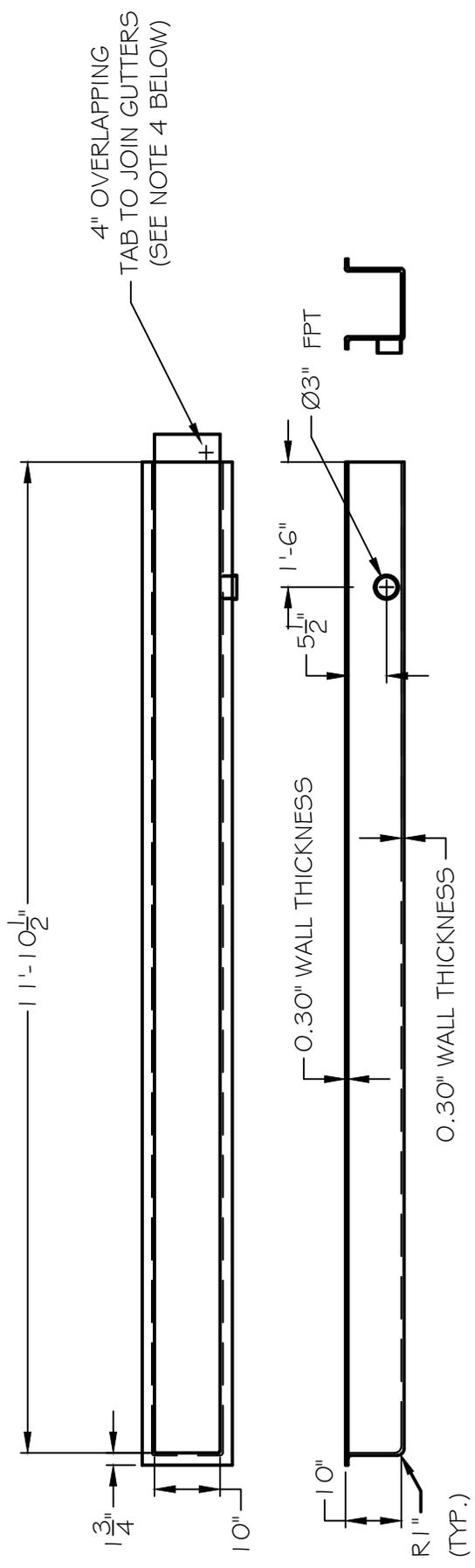
### SUPPORT DETAIL

|                                  |           |            |          |
|----------------------------------|-----------|------------|----------|
| BY:                              | DATE:     | DETAIL NO. | REV. NO. |
| C.G.                             | 11/7/2014 | 010        | 1        |
| TITLE STANDARD APRON DETAILS - 2 |           |            |          |

24' X 20' PANEL (SEE DETAIL 008)  
NUMBER OF PANELS AS REQUIRED



|   |           |            |          |
|---|-----------|------------|----------|
| BY:   | DATE:     | DETAIL NO. | REV. NO. |
| C.G.  | 11/7/2014 | 011        | 1        |
| TITLE: TYPICAL APRON INSTALLATION ISOMETRIC |           |            |          |



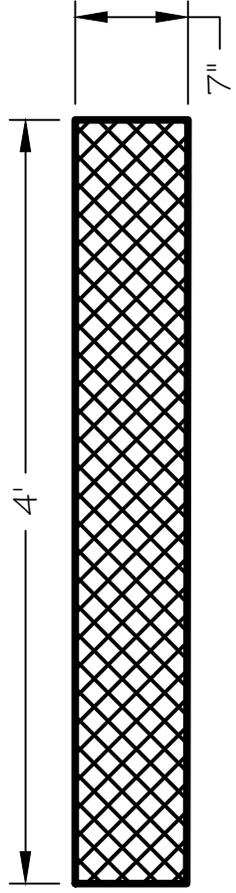
4" OVERLAPPING  
TAB TO JOIN GUTTERS  
(SEE NOTE 4 BELOW)

LEFT HALF OF GUTTER SHOWN, RIGHT HALF IS MIRROR IMAGE  
OUTLETS SHALL BOTH BE PLACED ON THE SAME SIDE, I.E. BACK SIDE OR FRONT SIDE

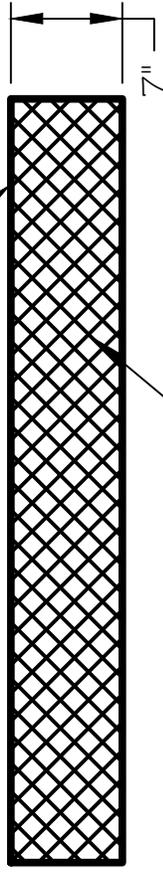
CONSTRUCTION NOTES:

- 1) LINEAR LOW DENSITY POLYETHYLENE RESIN SHALL BE 0.30" THICK.
- 2) LINEAR LOW DENSITY POLYETHYLENE SHALL CONTAIN LL 8460 LONG TERM UV-8 STABILIZER.
- 3) GUTTER SHALL INCLUDE ONE STANDARD STEEL GUTTER BASKETS (SEE DETAIL 013).
- 4) JOIN THE TWO GUTTER HALVES BY USING LEXEL CAULK BETWEEN THE TAB SURFACES AND USING SIX (6) 1/4" BOLTS WITH FENDER WASHERS TO SECURE THE TWO TABS TOGETHER.
- 5) USE 5/16" X 1 1/2" SCREWS WITH NEOPRENE WASHER TO FASTEN APRON PANEL AND GUTTER TO APRON FRAME.

|        |           |            |                 |
|--------|-----------|------------|-----------------|
| BY:    | DATE:     | DETAIL NO. | REV. NO.        |
| C.G.   | 11/7/2014 | 012        | 1               |
| TITLE: |           |            | STANDARD GUTTER |



FRAME, #4 RE-BAR, WELD ALL CORNERS THRU



1/8" THK, 1/2" EXPANDED STEEL, WELD TO BOTTOM, SIDES & ENDS

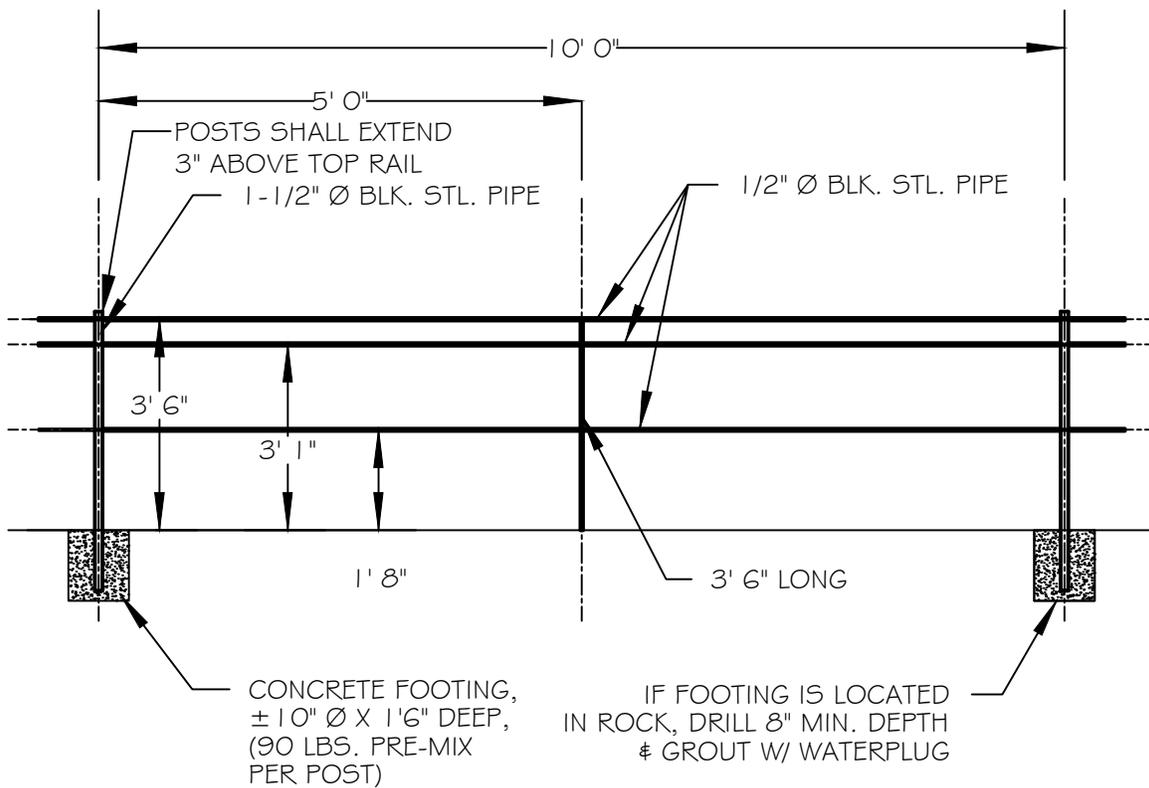
1/2" EXPANDED STEEL NOT REQUIRED ON ONE 4' SIDE



|  |                    |                   |          |
|--|--------------------|-------------------|----------|
| BY:<br>C.G.                            | DATE:<br>11/7/2014 | DETAIL NO.<br>013 | REV. NO. |
| TITLE:<br>STANDARD STEEL GUTTER BASKET |                    |                   |          |

NOTES:

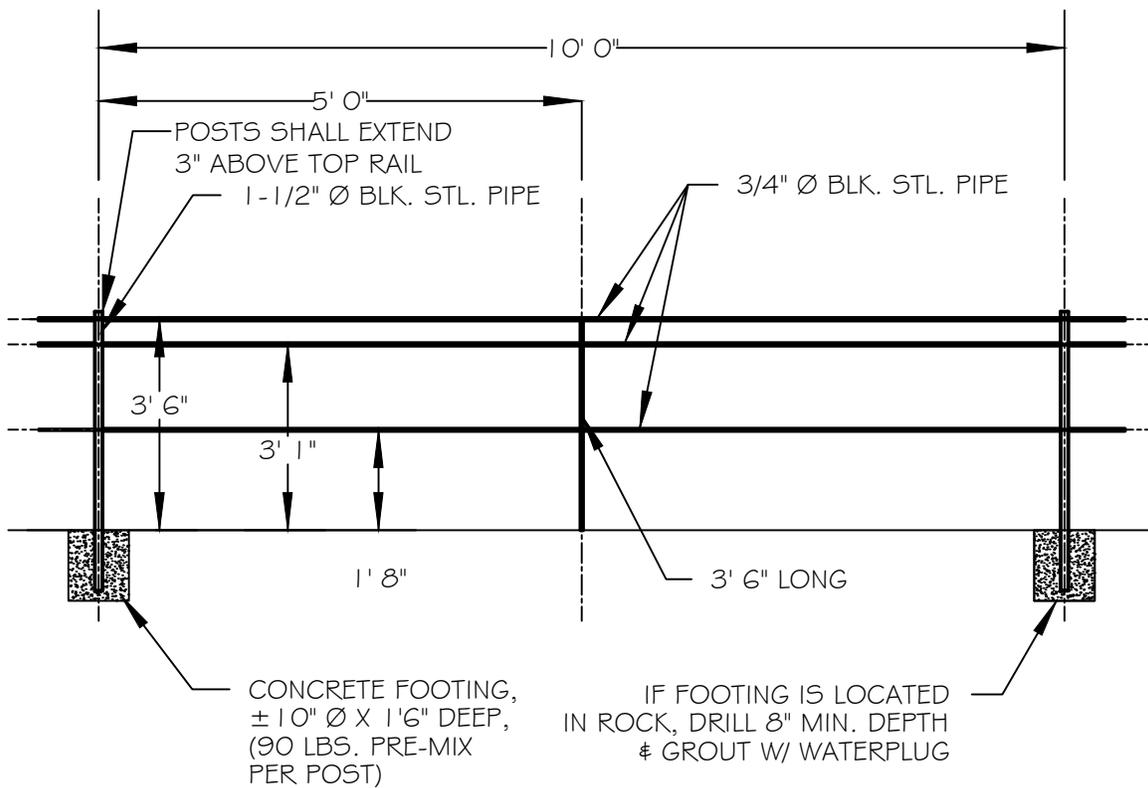
- 1) ALLOW POSTS TO SET PRIOR TO WELDING RAILS.
- 2) WELD ALL POSTS AND STAYS TO RAILS.
- 3) WELD ALL RAILS TO SAME SIDE OF POST (NO OFF-SETS).
- 4) PRE-CUT 1 1/2" POST TO 63" LENGTH.
- 5) TOP OF 1/2" STAYS WELDED LEVEL AND SMOOTH TO TOP RAIL.



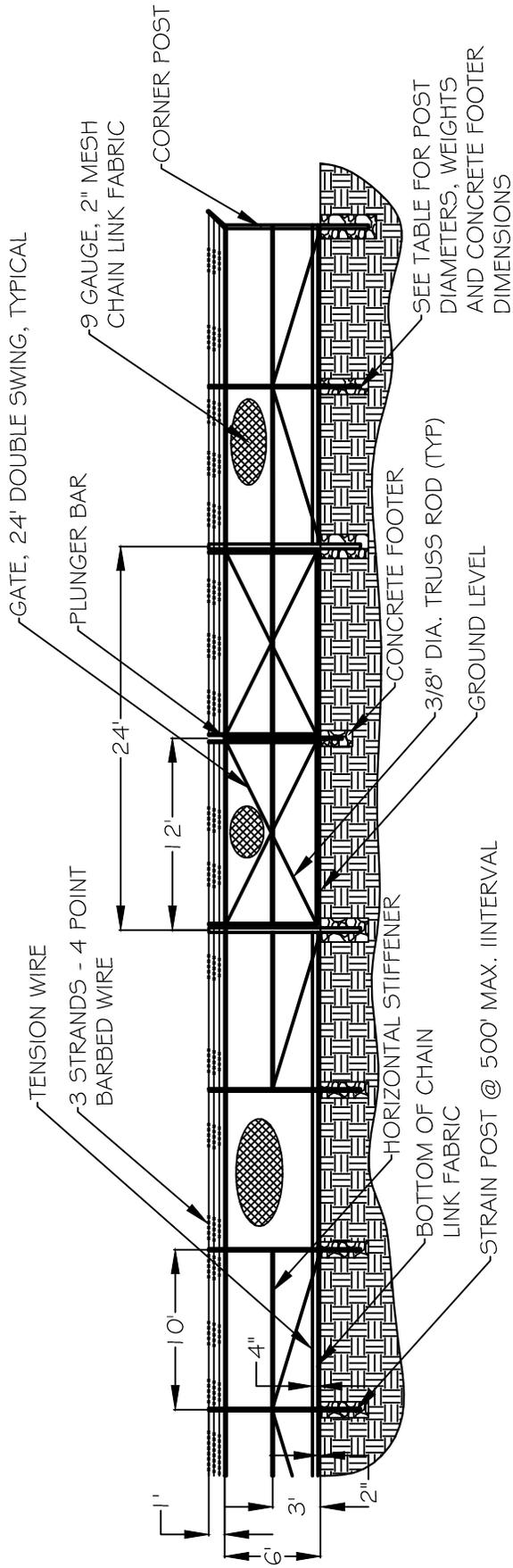
|  |           |            |          |
|--|-----------|------------|----------|
| BY:  | DATE:     | DETAIL NO. | REV. NO. |
| C.G.   | 11/7/2014 | 014        | 1        |
| TITLE REGULAR DUTY PIPE-RAIL ENCLOSURE FENCE |           |            |          |

NOTES:

- 1) ALLOW POSTS TO SET PRIOR TO WELDING RAILS.
- 2) WELD ALL POSTS AND STAYS TO RAILS.
- 3) WELD ALL RAILS TO SAME SIDE OF POST (NO OFF-SETS).
- 4) PRE-CUT 1 1/2" POST TO 63" LENGTH.
- 5) TOP OF 3/4" STAYS WELDED LEVEL AND SMOOTH TO TOP RAIL.

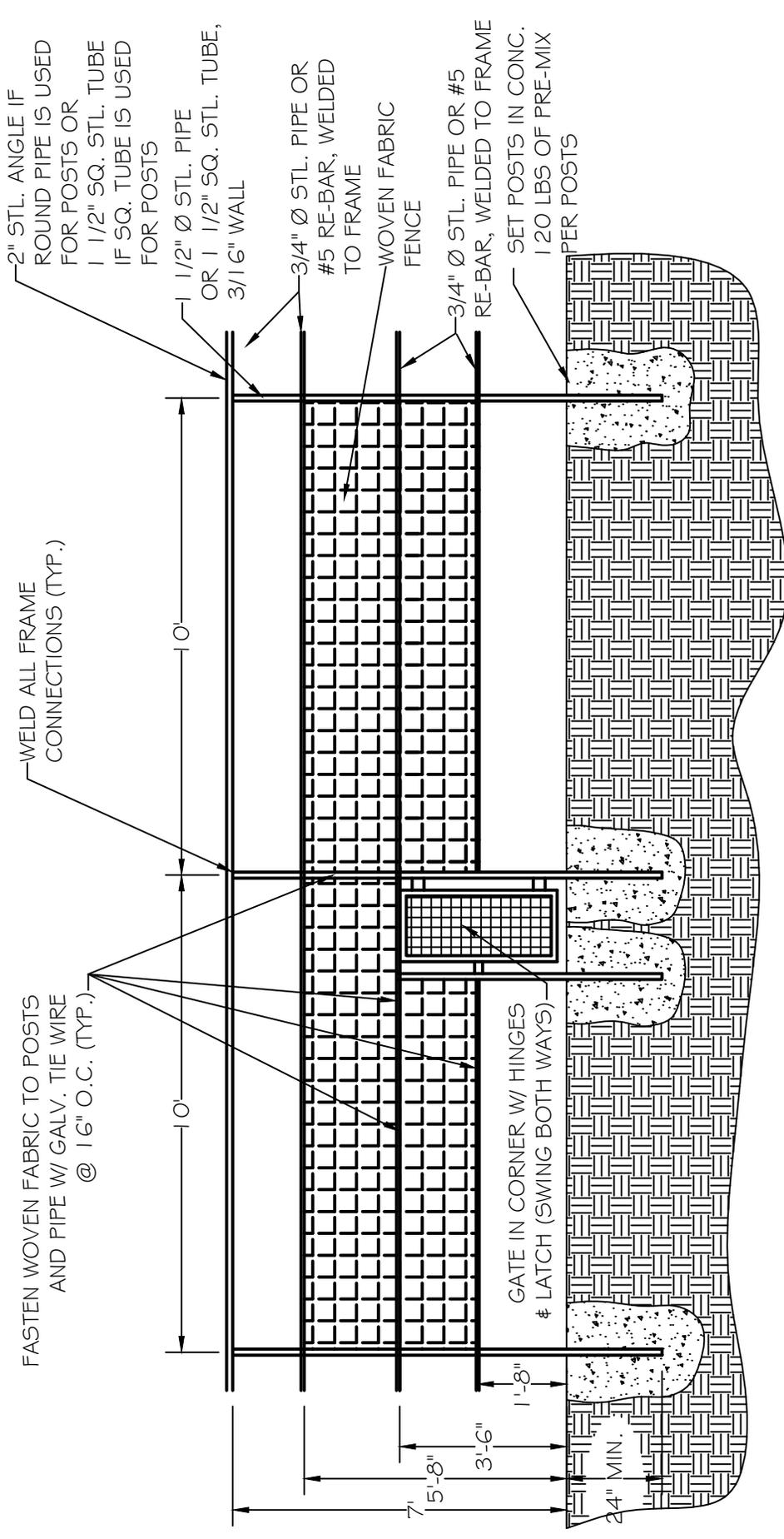


|   |                    |                   |               |
|---|--------------------|-------------------|---------------|
| BY:<br>C.G.                                   | DATE:<br>11/7/2014 | DETAIL NO.<br>015 | REV. NO.<br>1 |
| TITLE<br>HEAVY DUTY PIPE-RAIL ENCLOSURE FENCE |                    |                   |               |

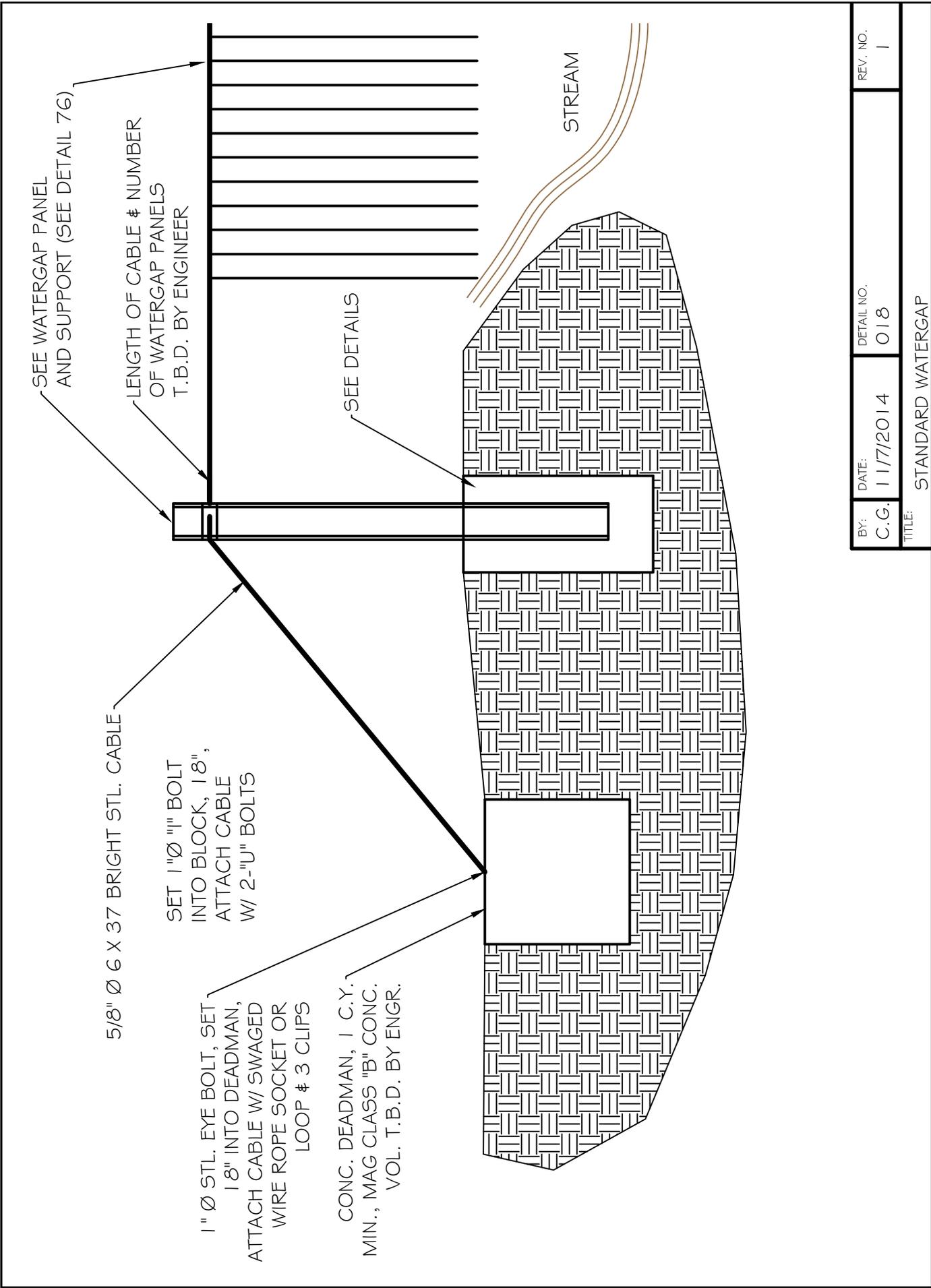


| MEMBER      | AISC SIZE    | OUTSIDE DIAMETER (IN.) | WEIGHT (LB./FT.) | FOOTER DIMENSIONS (MAG CLASS "C") |
|-------------|--------------|------------------------|------------------|-----------------------------------|
| CORNER POST | 2 1/2"       | 2.875"                 | 3.65             | 1'-4" Ø X 3'-6"                   |
| LINE POST   | 1 1/2"       | 1.900"                 | 2.72             | 1' Ø X 2'-6"                      |
| STRAIN POST | 1 1/2"       | 1.900"                 | 3.65             | 1'-4" Ø X 3'-6"                   |
| BRACE       | 1 1/4"       | 1.666"                 | 2.27             |                                   |
| STRETCH BAR | 3/16" X 3/4" | FLAT                   |                  |                                   |
| GATE POST   | 3 1/2"       | 4.000"                 | 9.11             | 1'-4" Ø X 3'-6"                   |
| TOP RAIL    | 1 1/4"       | 1.666"                 | 2.27             |                                   |

|                         |           |            |          |
|-------------------------|-----------|------------|----------|
| BY:                     | DATE:     | DETAIL NO. | REV. NO. |
| C.G.                    | 11/7/2014 | OIG        | 1        |
| TITLE: CHAIN LINK FENCE |           |            |          |



|                               |           |            |          |
|-------------------------------|-----------|------------|----------|
| BY:                           | DATE:     | DETAIL NO. | REV. NO. |
| C.G.                          | 11/7/2014 | 017        | 1        |
| TITLE:<br>ELK ENCLOSURE FENCE |           |            |          |

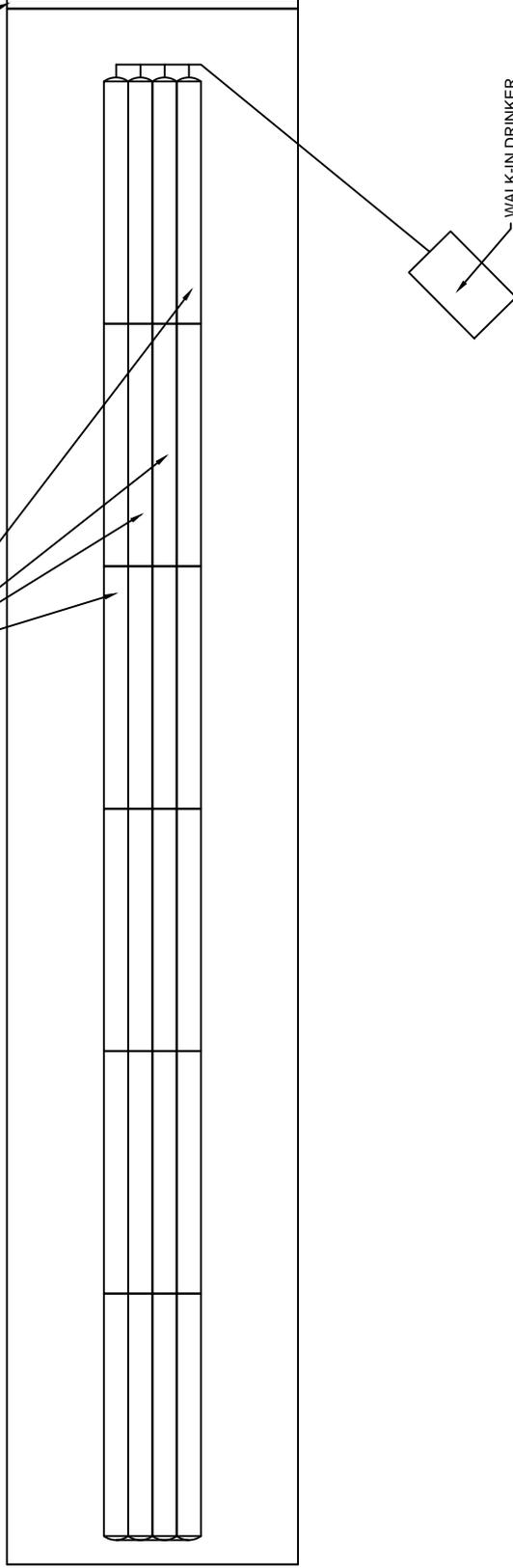


|                          |           |            |          |
|--------------------------|-----------|------------|----------|
| BY:                      | DATE:     | DETAIL NO. | REV. NO. |
| C.G.                     | 11/7/2014 | 018        | 1        |
| TITLE: STANDARD WATERGAP |           |            |          |



24" DIA. X 120' PVC STORAGE TUBES (TYP. 4)

STANDARD GUTTER (SEE DETAIL 012)



BY:

DATE:

DETAIL NO.

REV. NO.

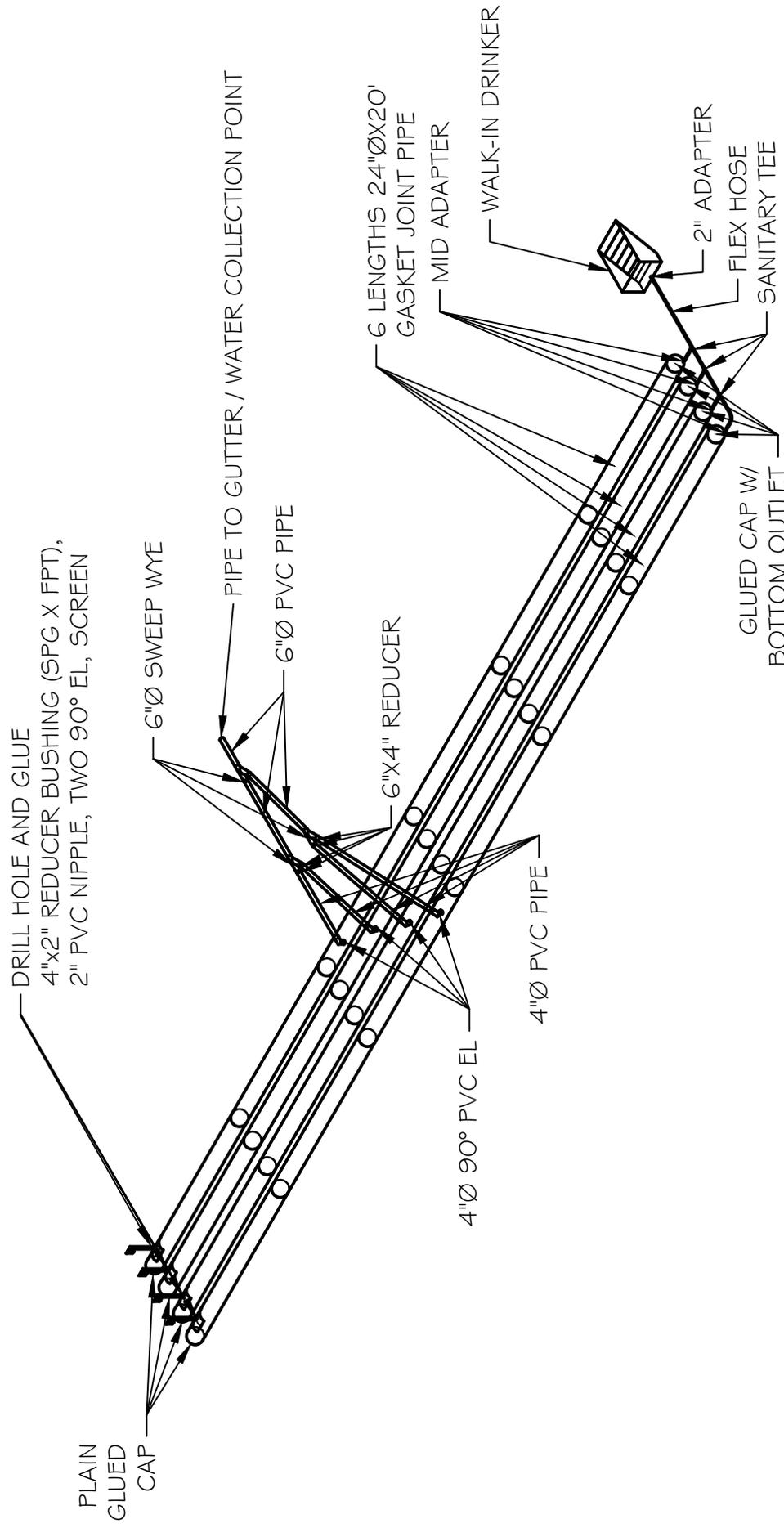
C.G.

1/17/2014

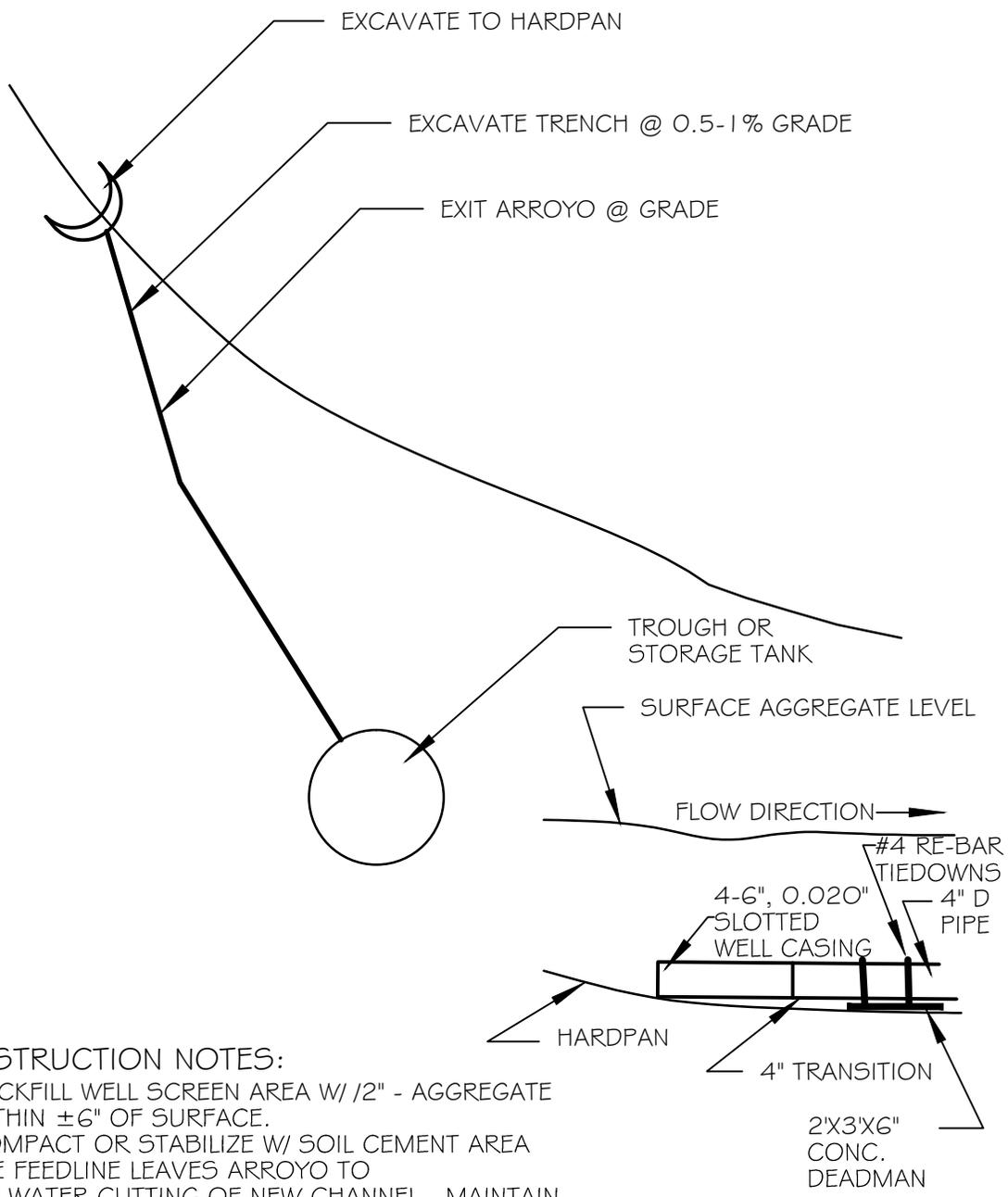
020

1

TITLE: WATER CATCHMENT PVC TANK PLAN VIEW



|   |           |            |          |
|---|-----------|------------|----------|
| BY:   | DATE:     | DETAIL NO. | REV. NO. |
| C.G.  | 11/7/2014 | 021        | 1        |
| TITLE: 24" DIA. PVC PIPE TANK INSTALLATIONS - SCHEMATIC |           |            |          |



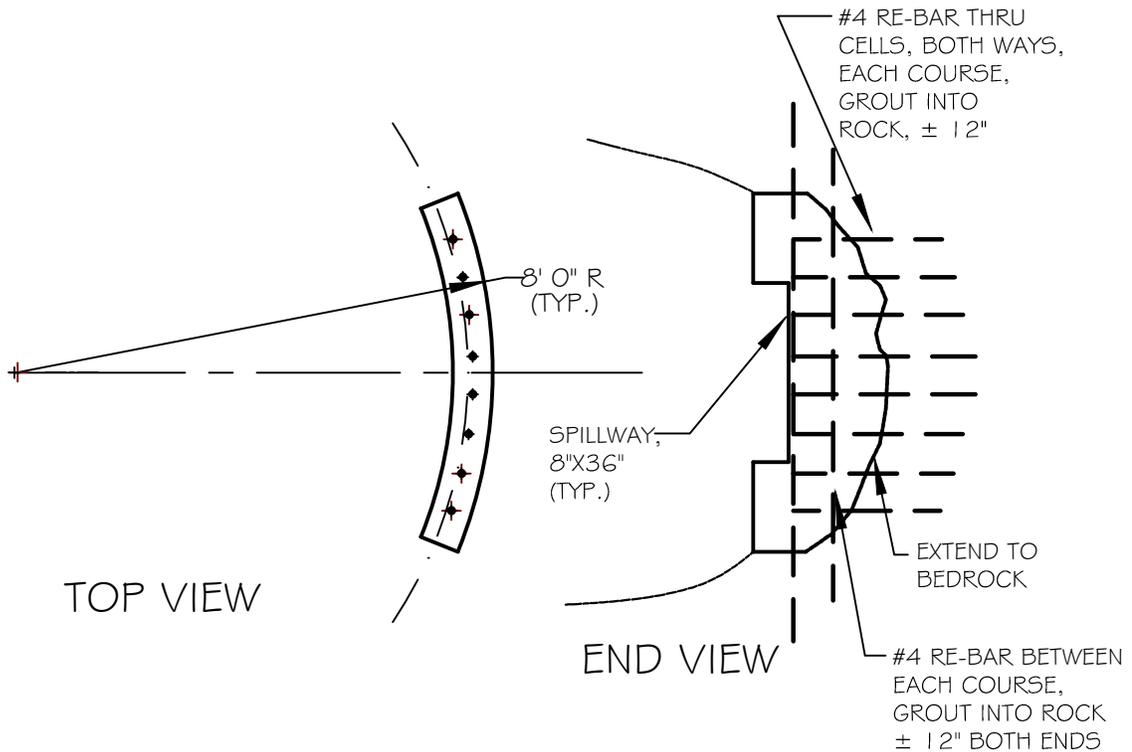
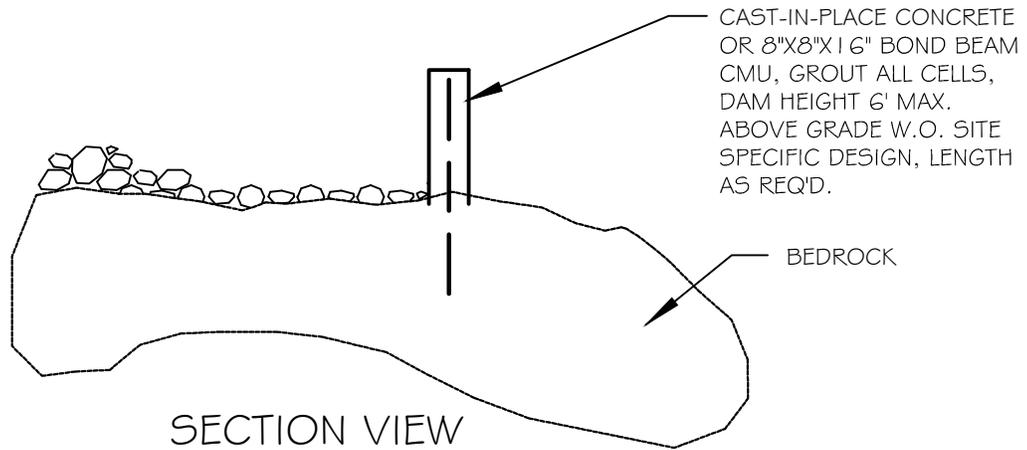
**CONSTRUCTION NOTES:**

- 1) BACKFILL WELL SCREEN AREA W/ 1/2" - AGGREGATE TO WITHIN ±6" OF SURFACE.
- 2) COMPACT OR STABILIZE W/ SOIL CEMENT AREA WHERE FEEDLINE LEAVES ARROYO TO AVOID WATER CUTTING OF NEW CHANNEL. MAINTAIN FLAT GRADE IN THIS AREA.

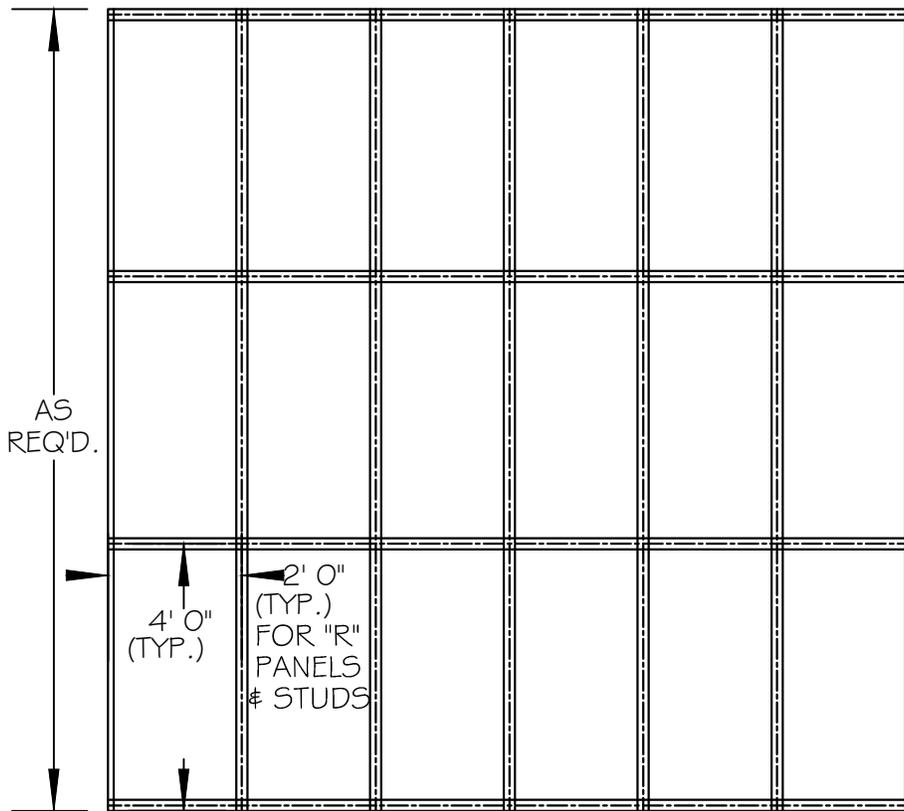
|   |           |            |          |
|---|-----------|------------|----------|
| BY:   | DATE:     | DETAIL NO. | REV. NO. |
| C.G.  | 11/7/2014 | 022        | A        |
| TITLE<br>SUB-SURFACE COLLECTION POINT SCHEMATIC |           |            |          |

NOTES:

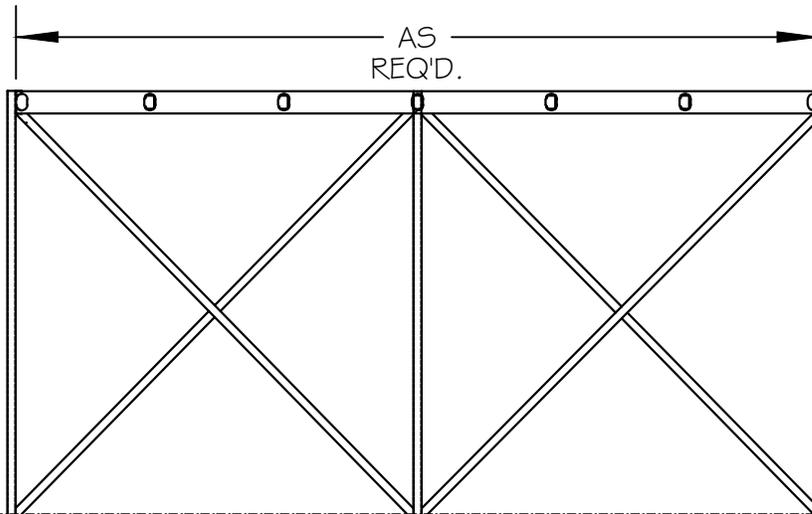
- 1) DIMENSIONS AND RADIUS OF CURVATURE MAY VARY DEPENDING ON FIELD CONDITIONS.
- 2) DAM SHALL BE FACED ON UPSTREAM SIDE W/ APPROVED WATERPROOFING MATERIAL.
- 3) MAXIMUM ALLOWED HEIGHT 6' WITHOUT SEALED, DETAILED ENGINEERING DESIGN.



|  |           |            |          |
|--|-----------|------------|----------|
| BY:                                      | DATE:     | DETAIL NO. | REV. NO. |
| C.G.                                     | 11/7/2014 | 023        | A        |
| TITLE<br>STANDARD "TINAJA" DAM SCHEMATIC |           |            |          |

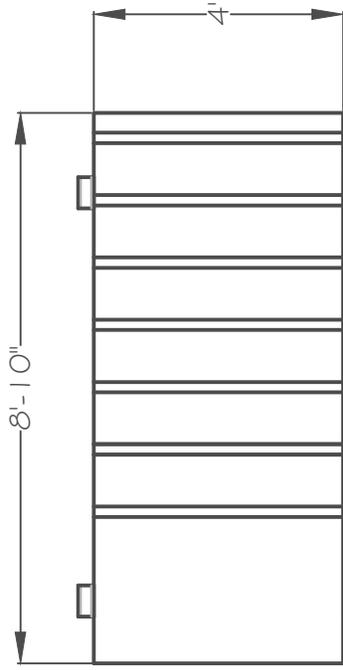


CONSTRUCTION NOTES:  
 1) SHADE STRUCTURE SHALL BE CONSTRUCTED OF 1 6 GA. STL. STUDS & CHANNEL & 26 GA. STL. "R" PANELS.  
 2) SHADE SUPPORTS SHALL BE CONSTRUCTED FROM 1-1/2" SQ. STL. TUBING.  
 3) 20-30 PSF. CAMO. LOAD



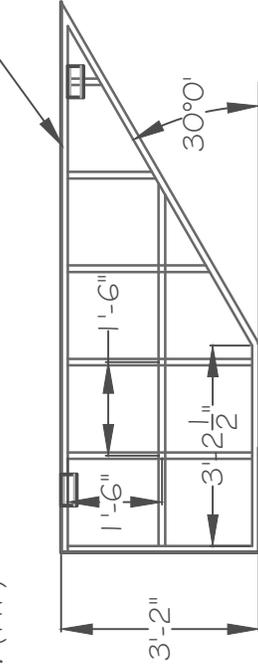
DRILL ± 6" INTO STONE

|                 |           |            |          |
|-----------------|-----------|------------|----------|
| BY:             | DATE:     | DETAIL NO. | REV. NO. |
| C.G.            | 11/7/2014 | 024        | A        |
| TITLE SUN SHADE |           |            |          |

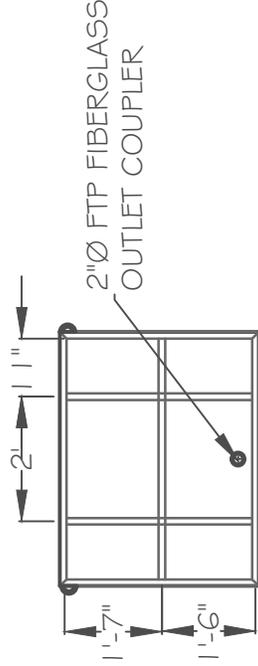


FIBERGLASS LIFT LUGS  
4 PLCS. (TYP)

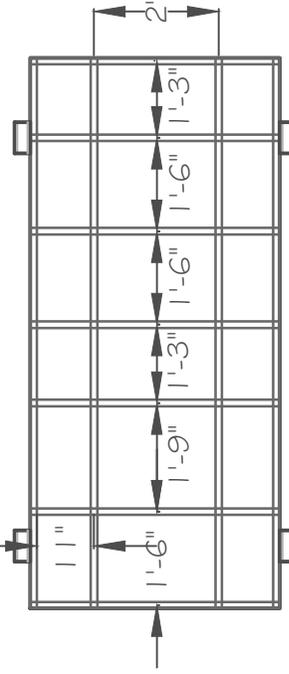
STL. FRAME, 1 1/2"X3/16" SQ. TUBE, WELD ALL JOINTS,  
GRIND SMOOTH, GLASS IN PLACE INSIDE & OUT



SIDE VIEW



END VIEW



BOTTOM VIEW

CONSTRUCTION NOTES:

- 1) WALL THICKNESS, 1/4" MIN.
- 2) LAM. SCH., CHOPPED STRAND, 70% RESIN, 30% GLASS
- 3) GELCOAT INTERIOR & EXTERIOR
- 4) APPROX. WT. 1400 LBS.
- 5) INTERIOR SHALL HAVE 2" SQ. FIBERGLASS RETAINMENT RIBS @ 1' O.C., ACROSS INTERIOR OF TROUGH

|             |                    |                   |          |
|-------------|--------------------|-------------------|----------|
| BY:<br>C.G. | DATE:<br>11/7/2014 | DETAIL NO.<br>025 | REV. NO. |
|-------------|--------------------|-------------------|----------|

TITLE:  
38" REGION 4 WALK-IN TROUGH

## MISSION

To conserve Arizona's diverse wildlife resources and manage for safe, compatible outdoor recreation opportunities for current and future generations



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